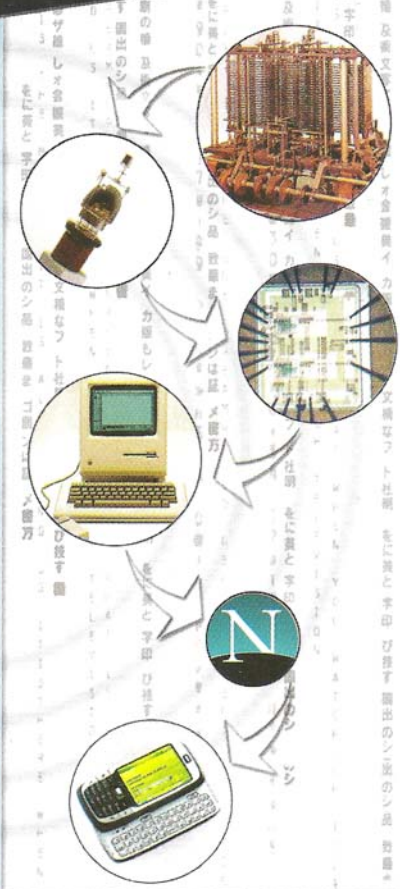
digit
November 2007

Fast Track to COMPUTING

AGES, EVENTS, EVOLUTION



YOUR HANDY GUIDE TO EVERYDAY TECHNOLOGY

Fast Track to Computing

Ages, Events, Evolution

By Team Digit

Credits

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A Ridiculously Fascinating Journey

You're at your desk and fire a printout. Data on your hard disk, stored as tiny magnetic polarisations that a head some nanometres above them picks up, is sent over some wires as tiny variations in voltage to the printer. This, now, picks the data up into its RAM; what happens is, the voltage variations in the wire get converted into voltage changes in some transistors a few microns large. Then the print head: etc. etc. ... you get the idea. All this is routine, but it's insanely complex. Just how did we get to where we are? Sitting at a desk and firing a print, from using gas lamps at night just a few hundred years ago?

Edison invented the bulb, Baird (this is disputable) brought in the TV, and more, but here we're interested in just how the information age was shaped.

There are many ways to view it. You can think about it as inventors and innovators with their creations; you can think about it as pieces in a puzzle; you can think about it as fierce competition in capitalism-driven countries (where most of all this happened). The fact is, we have chosen this path. And what's happened along the journey is what we bring you here in this book.

We first talk about prehistoric times leading up to 1949, clubbing it all into one chapter, then start off with the decades: the 50s, the 60s, and so on up to the 00s (if you like to call it that). We then look at what prominent (and not-so-prominent but nevertheless important) figureheads in tech have to say about the future of this journey we're dwelling on.

Make your own trends: we see a gradual shift from innovation to building upon existing ideas. Derive your own insights: we see that Microsoft's supremacy has been much dictated by fate (or so it would seem). Take your pleasure in this year-wise presentation of the facts. It's a massive build-up, this—from the adding of numbers to the precise control of the extra-planetary behaviour of electrons.

CONTENTS

Abacus To Transistor

How tech came to be—and specifically, how it came to be what it is—is a continuum. It's also a story of specific inventors and innovations; it needs to be seen in both these contexts. One could say it began with the invention of the abacus—or with that of the transistor. Here in this beginning chapter, we trace "tech" to the point of 1949. That year is no turning point; it just makes things more readable!

1.1 What Is This About?

In the pages to follow, you'll see a lot of years and months and a lot of events. They seem isolated. What picture do they attempt to paint? What are we getting at? In fact, what is this book about?

The simple answer would be that it is a history of computing. "History is bunk," a notable American once said, and we couldn't agree less. To that's man's credit, he said it in a different context. Here, we're talking about what brought us to where we are, insofar as we are technology consumers and enthusiasts.

The complex answer is, well, slightly more complex: all of computing, information technology, computation, etc. is based upon one thing—the manipulation of ones and zeroes, or bits. It *is* all just that—whether it's the multiplying of two numbers, as was attempted on machines four hundred years ago, or the idea of meeting a schoolmate on Orkut. How?

Well, there are human needs, and computing happens to be one solution to those needs. To emphasise, *many* human needs can be dealt with by computation. So the computing—playing with those bits—is the base, and our needs and solutions are placed upon that foundation.

To tie these two together, what we have is a situation where *how* bits are manipulated dictate how some (in fact, many) human needs are handled. That is the path we have taken. So, for example, when you "meet" that friend on Orkut, what's happening? First you see his picture on the site. That picture is made of bits. The site itself is bits on a server. Then you send him a message—those are bits travelling over the fibre or telephone line. And so on. Now what's interesting here is the following:

(a) Bit-manipulation is the beginning; we go on to transistor manipulation, then to integrated circuit manipulation, and so on. Structure upon structure, vertically; branching out hori-

zontally into "peripheral" things (think actual computer peripherals, such as printers, or spin-offs such as mobile phones). This is nothing but the edifice—not monolithic, not entirely networked, not entirely fuzzy either, but just one complex ecosystem—called information technology.

(b) The possibility of more and more advanced data manipulation leads to more and more possibilities in the solving of human needs.

(c) Advanced manipulation also leads to the creation of new needs—that's why tech advances.

And there we stand today, collectively supported by this framework of what may loosely be termed "networked information"; and that's what all that follows is about—how we came to stand on and depend upon this framework.

1.2 Before Babbage

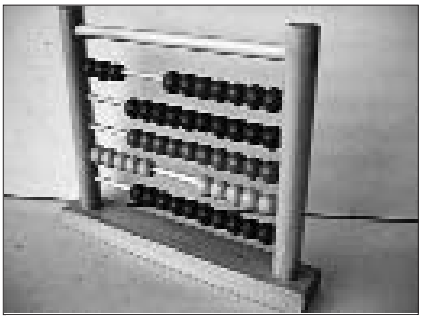
Circa 500 B.C.

The abacus is probably what most people associate with the phrase "ancient counting machine." It's not entirely ancient—schoolchildren in countries such as China and Japan are still taught how to use it for basic arithmetic operations. Interestingly, skilled abacus users can even find square and cube roots of numbers using the abacus!

You probably know what an abacus looks like—it's a frame with vertical rods, a horizontal crossbar, and beads. It is based on the decimal system: the first vertical bar is for units, the second for tens, and so on. Space does not permit a discussion of how the abacus works, and you'd do well to visit **http://science.jrank.org/pages/2/Abacus.html** for an explanation.

The device was first used in Babylon around 500 B.C., but the form of the abacus most people (who have seen it!) are familiar with was first used in China around the year 1300.

All the mechanical calculators that follow were invented in Europe: that's where scientific research blossomed at the time.

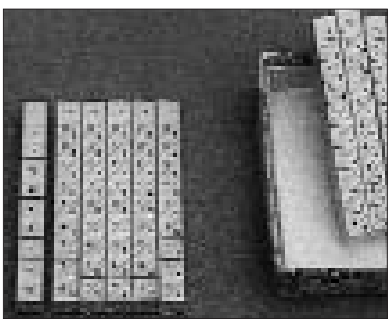

What was probably the first calculator!

14??

It appears Leonardo da Vinci had created a calculating machine; there seems to be a controversy about it, and it involves a Boston museum, so we can't really speak about this one; refer to **www.webcom.com/calc/leonardo/leonardo.html** if you're interested.

1614

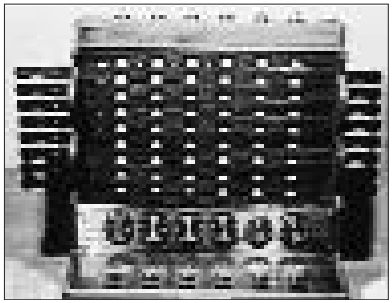
Scotsman and mathematician John Napier invented a system of moveable rods, referred to as Napier's Rods, which allowed for multiplication, division, and square and cube root calculation. The idea, vaguely put, was to move the rods and place them in boards of a certain construction. Well, that's as vague as it gets; visit **www.cee.hw.ac.uk/~greg/calculators/napier/about.html**.


Napier Rods—yet another milestone in the quest for manipulating numbers

1623

An interesting device was developed by Wilhelm Schickard who lived in Tübingen, Württemberg (which is now in Germany): it was called a "Calculating Clock." It was mechanical, naturally, and was capable of adding and subtracting six-digit numbers. It employed wheels for operations; one revolution of the "units" wheel incremented the "tens" wheel. You get the idea. What's especially interesting here is that

it warned of an overflow by ringing a bell!



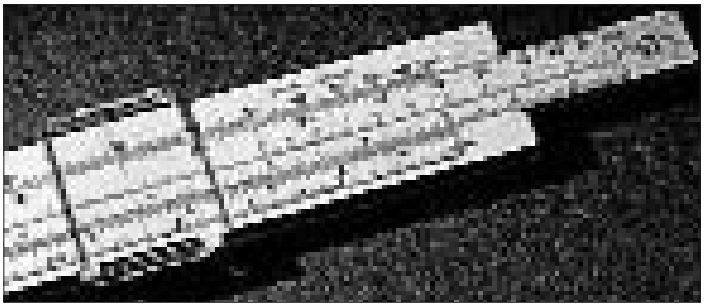
The Calculating Clock: fascinatingly complex-looking

And then, in...

1625

...William Oughtred invented the slide rule. We think many of you—at least the old-timers—are familiar with this one. A manual from 1960 said, "A computer who must make many difficult calculations usually has a slide rule close at hand." Note that "computer" here referred to a person; it was only later that the term got applied to a machine!

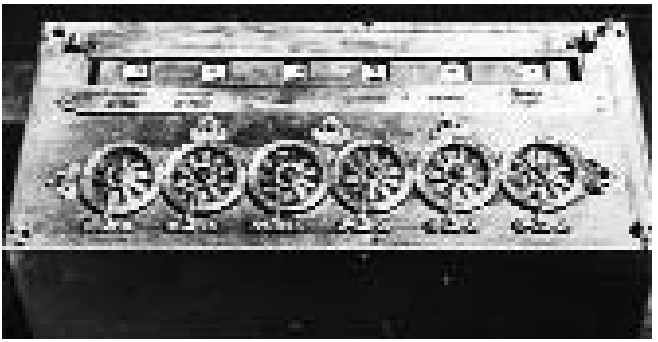
How the slide rule works, in fact, a good tutorial, is at www.sphere.bc.ca/test/howto.html.



A typical slide rule—which you *should* know about!

1642

French mathematician Blaise Pascal (of Pascal programming language fame) built the narcissistically-named Pascaline, a mechanical adding machine. It was limited compared to Schickard's Calculating Clock, but the Pascaline became much more popular. You'll often find the Pascaline quoted, and seldom the Calculating Clock. Pascal actually sold about 12 of them.

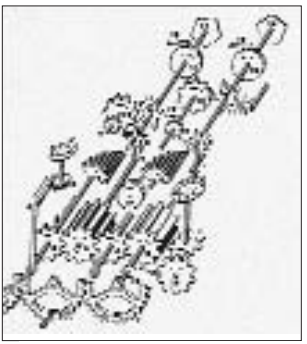


The second-most famous calculator of the 17th century

1671

The great German mathematician Gottfried Wilhelm von Leibniz designed a multiplying machine called the Stepped Reckoner. It could multiply numbers of up to five and 12 digits to give a 16-digit result.

We mention this because Leibniz, if you remember, invented the calculus at around the same time as Newton, and there are hard-liners on both sides who argue for their respective champion regarding the invention.



Leibniz's Stepped Reckoner: a diagram, not the actual thing

1786

J H Müller, an army officer, actually predated Charles Babbage (we'll come to the man later) in regards the idea of the "Difference Engine." Müller envisioned (it was never built) a mechanical calculator for determining polynomial values using Newton's method of differences. Now that's advanced maths, and it implies two things: (a) We won't go into it, and (b) It shows that mechanical calculators, by the end of the 18th century, had progressed well beyond addition and multiplication.

1820

Beyond concepts and selling 12... mass production! Frenchman Charles Xavier Thomas de Colmar developed his Arithmometer, the first mass-produced calculator. Its multiplicative operations followed the same general principle as Leibniz's machine. This was the most *reliable* calculator developed thus far, and that was probably why it was mass-produced. This, and other machines with the same overall design, continued to be sold right up to around 1910.

1.3 Babbage

Who was the Father of Computing? There are several popular answers, depending on context; the favourites seem to be, in this order:

1. Alan Turing, who laid down certain rules regarding what a computing machine is
2. Charles Babbage, who designed what we'll describe now
3. The inventors of the transistor (arguably the greatest invention of the 20th century and the 21st century thus far): John Bardeen, Walter Brattain, and William Shockley
4. Jack Kilby of Integrated Circuit fame

But before we begin about Babbage, here's what a "difference engine" is, from Wikipedia (handle with care): *A difference engine is a special-purpose mechanical digital calculator designed to tabulate polynomial functions. Logarithmic and trigonometric functions can be approximated by polynomials.*

If you don't know what these are, suffice it to say that operations on polynomials, trigonometric functions, and such are much more advanced than arithmetic operations. In addition, the first computers were, like today, number-crunchers (though they didn't crunch much); the point is that ~direct mathematical number crunching~ was what they were destined for, unlike, say, the number-crunching that a graphics card does (because it's ultimately for the sake of pixels). In sum, the early computers just operated on numbers, period.

Numbers were the input, numbers were the output.

Babbage is such an important figure, a few links must be mentioned.

For historical documents:
www.fourmilab.ch/babbage/contents.html
For lots of links:
www.zyvex.com/nanotech/babbage.html
For a biography:
www-history.mcs.st andrews.ac.uk/Biographies/Babbage.html
For lots of interesting stuff:
http://ei.cs.vt.edu/~history/Babbage.html


Behind the mechanics, the mathematics, the machine: Charles Babbage, who started it all

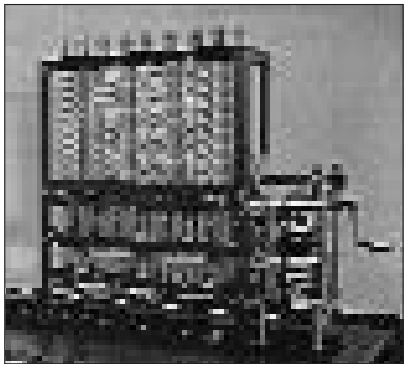
1822

Charles Babbage designed his first mechanical computer, a prototype for his Difference Engine. One must remember that Babbage invented two machines—the Analytical Engine and the Difference Engine (cf. Müller, 1786). Both were too complex to actually be built. The Analytical Engine, which Babbage outlined in 1833, used punched cards for input—very interestingly similar to the early "real" computers.

1832

Babbage, in collaboration with Joseph Clement, an engineer and draughtsman, produced a prototype segment of the Difference Engine, which operated on six-digit numbers, and which could tabulate quadratic polynomials. (A polynomial is something like a2 + b; a quadratic polynomial is something like a4 + b3—c2 + d.) The Engine was planned to be the size of a room. The output digits, it was planned, would be punched onto a soft metal plate; a printing press could use it, and voila—readable output!

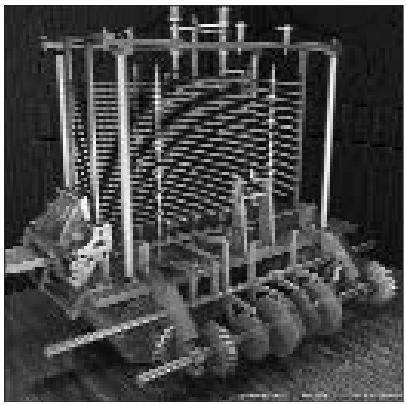
Nothing beyond this prototype segment was actually built.



The all-famous Difference Engine: a modern interpreted drawing

1834

This was the year of the conception and design of the Analytical Engine. The program was stored on punch cards. The inventor continued work on his design for many years; the machine would operate on 40-digit numbers, which is, come to think of it, huge. He called the CPU the "mill," and the memory he called, pretty obviously, the "store," which would hold a hundred numbers. Babbage's plans for his Analytical Engine were complex: several punch card readers, both for programs and data. There was also provision for *conditional jumps*—as in "if-then" statements—on this *mechanical* device! As if that weren't enough, the *meaning* of the instructions would be interpreted depending on the positioning of metal studs in a slotted barrel (all these words to give you an idea of the complexity). At the end of it, the machine would do an addition in three seconds and a multiplication (or division) in two to four minutes.



This image, of a model of the Analytical Engine, won an honourable mention for technical merit in the March/April '99 round of the Internet Raytracing competition

The Difference Engine project was cancelled in

1842, because of cost problems, and because of Babbage spending too much time redesigning the Analytical Engine.

1842–1843
If you've heard of Babbage, you've probably heard of Ada Lovelace, who is referred to by various names. (The Right Honourable Augusta Ada, Countess of Lovelace; Ada Lovelace; Augusta Ada Byron, Ada Byron, and some permutations...) She wrote to Babbage about a plan for how the Difference Engine might calculate Bernoulli numbers. This plan is now regarded "the first computer program."

There is a long and fascinating story about the relationship (no, it was not amorous) between Babbage and Lovelace; visit **www.hwwilson.com/print/leaders_info_TBernersdlee.htm** for a comprehensive, readable account.

Later...

More work on the Engines followed, and all of it was cancelled—only the original segment we referred to earlier was actually built. Babbage's ideas never made it to the factory.

In 1989—91, in true-blue English-heritage spirit, a team at London's Science Museum used modern components that had the basic clumsy qualities of those that Babbage and Clement used. Playing around with the design for the Difference Engine, they found the machine does indeed work. Babbage stands tall, respected, redeemed.

1.4 The Mathematical Foundation

1848
This is another of Britain's contributions to the development of computing: British Mathematician George Boole devised binary algebra, soon called Boolean algebra. This was essential for a

binary computer to be developed, which happened almost a hundred years after.

You see examples of Boolean algebra all the time: the NOT and OR operators in Google, "NAND" as in "NAND Flash device," and so on. But it runs much, much deeper.

So what is Boolean algebra? Very simply put, it's the familiar AND, NOT, etc. that you're familiar with—1 AND 0 equals 0, 1 OR 0 equals 1, 1 XOR 1 equals 0, and so on. "Truth tables" is the term most commonly used in conjunction with these: for example, the truth table for the XOR operation goes thus:

George Boole's system laid the foundation for the computers to come

This	XOR	This Equals
0	0	0
0	1	1
1	0	1
1	1	0

Such operations are essential to logic circuit design, which are essential to higher-level building blocks like integrated circuits.

For a very basic introduction to Boolean algebra, refer
http://tinyurl.com/2sknk4

For a complete discussion of why Boolean algebra is fundamental to the development of computers, refer
http://tinyurl.com/2tfhbn

1.5 Towards The Twentieth Century

1878

Out of the blue (Cuba, to be precise), a Spaniard called Ramón Verea came to New York City at the end of the US Civil War. He traded Spanish gold and banknotes, which got him interested in calculation. Necessity is... and so, this year, Verea created a calculating machine and was granted a patent for it.

There were calculators before Verea's invention, but they all performed repeated addition operations to get a multiplication result. Verea's contribution lay in seeing how to perform multiplication with one stroke of a lever. His machine was based on a ten-sided metal cylindrical structure.

Scientific American ran an article about Verea's calculator, but the man never tried to market his own invention—almost in scorn. He seemed to have just wanted to prove that "backward" Spaniards could come up with inventions just like Americans and Englishmen could.

By the end of the century, all mechanical-calculation systems had switched over to Verea-type systems.

1885

One more mass-production milestone: American Frank Baldwin and T Odhner, a Swede living in Russia, independently and simultaneously came up with a multiplying calculator that was more compact than the Arithmometer. This was not based on, but was a significant extension of, Leibniz's machine (see 1671). Again, space constraints dictate that we direct you to a URL to find out more: www.xnumber.com/xnumber/mechanical2.htm.

1886 And 1889

In 1886, Dorr Felt, who used to work in a machine shop, created, in Chicago, his Comptometer. This was the first mechanical calculator where the data was entered by pressing keys rather than by

other mechanisms such as dialling. In 1889, Felt went on to bring out the very first printing desk calculator.


Felt's Comptometer: press, don't dial!

Calculators had come of age; it was now time for computers.

1890

It'll seem ridiculous now, but the 1880 US census took seven years to compute—all the "computation" was done by hand! The US government, therefore, in anticipation of the increased population, put out a competition to find a better way. (They didn't want the census computation to take longer than 10 years, for obvious reasons...) So an employee of the census department called Herman Hollerith, borrowing Charles Babbage's idea, used punched cards for data storage. And what might have taken longer than 10 years took six weeks—yes, weeks.

Needless to say, Hollerith won the competition; but needful to say, Hollerith founded, in 1896, the Tabulating Machine Company.

Which went on, in 1924, to merge with another company and become International Business Machines—known more familiarly as IBM.


Herman Hollerith founded the Tabulating Machine Company; he is called the Father of Information Processing

From rochester.edu (our italics): (Hollerith's) methods, which were used well into the 1960s, offered a foundation for the future collection of all types of data. With his invention Hollerith allowed for the creation of one of the most dominant corporations of the computer age and *secured his place in history as the father of information processing.*

1899

And so, at the fag end of the 19th century, lots of things had been invented—not just in com-

puting or calculating, but in other fields as well. That must have seemed enough for Charles Duell, the then-director of the US Patent Office, because he remarked, "Everything that can be invented has already been invented." This is debated, but whatever the story behind it, we have an indication that the world was pretty pleased with what it had accomplished until then.

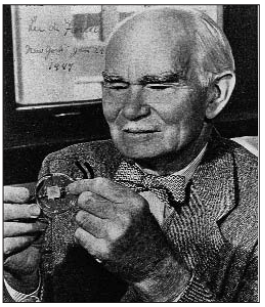

The punched-card system by Hollerith at work, counting people

1.6 The Vacuum Tube And Flip-Flops

1906

If you've heard of computers, you've heard of vacuum tubes. And if you've heard of those, you *should* have heard of Lee de Forest, who invented them: his first was called the Audion. De Forest helped propel the world into the Electronic Age. Where were vacuum tubes not used once they were invented? TV, radio, and later on, computers...

The site is, very interestingly, poorly designed—in fact, the homepage is near-kiddish: **www.leedeforest.org**. But we learn from there that during his lifetime, Lee de Forest received over 180 patents; his most significant was the three-element vacuum tube. And, about the Audion: "Earlier Thomas Edison's electric lamp had been modified by the Englishman, Ambrose Fleming, who added a second element, called a plate, and called it the Fleming Valve. By 1906 de Forest had modified Fleming's Valve by adding a grid to control and amplify signals, and called his device the Audion."


One of the men who thrust us into the Electronic Age

The ability to control and amplifying signals does have its importance in

the creation and manipulation of ones and zeroes...

This was in everything electronic—before the transistor came in

Visit www.pbs.org/transistor/album1 /addlbios/deforest.html for an amusing little video (it's at the right of the screen) of how the grid or gate that de Forest introduced helps control the flow of electrons. Visit www.pbs.org/wgbh/aso/databank/entries/btfore.html for what exactly the development consisted in. Also see figure below.

Suffice it to say that it would have been impossible to make digital electronic computers without the introduction of the vacuum tube.

1919

It is difficult to explain to a general audience what a flip-flop is. It is also difficult to overstate its usefulness. Technically, it is a bi-stable multivibrator, and that means it has two stable states, meaning it can *hold* a bit. Sort of important when it comes to computers—a nice building block!

British physicist W H Eccles and F W Jordan published the first flip-flop circuit design in 1919. It was then called the Eccles-Jordan circuit.

A "stable state" means just that—there are electronic circuits or devices that can go into one state or another when propelled by a current, but without staying in that state. A bi-stable multivibrator, then, is important because it has *two* stable states. You give it a current and tell it to become a 1, and it obeys; change it and tell it to become a zero, and it does so.

Now here's from foldoc.org: "Early literature refers to the 'Eccles-Jordan circuit' and the 'Eccles-Jordan binary counter,'

using two vacuum tubes as the active (amplifying) elements for each bit of information storage. Later implementations using bipolar transistors could operate at up to 20 million state transitions per second as early as 1963."


The other William Henry!

State transitions mean what the term sounds like, and naturally, changes in state are essential to information processing and flow. Besides, that excerpt highlights that the flip-flop used the vacuum tube (which de Forest introduced), and the comparison with transistors (we'll come to that bit in a bit) is illustrative of exponential progress.

For information on flip-flops (you'll need to at least know about logic gates), visit **http://wearcam.org/ece385/lectureflipflops/flipflops/.**

Off-topic, we should quote this from the people's encyclopaedia of Web 2.0 fame: "Frank Wilfred Jordan invented together with William Henry Eccles the so called "flip-flop" circuit in 1919. There is little else known about him." Indeed, try Googling him!

1.7 IBM

1924

Several mergers had resulted in the Computing-Tabulating-Recording Company; this was renamed International Business Machines Corporation in 1924 under Thomas J Watson Sr. as president. By that time, the C-T-R Company's business had expanded in terms of location as well as function; they already had three manufacturing facilities in Europe.

A little known fact is that apart from working at the forefront of computer technology, IBM was also involved in social reform

and responsibility: during the great depression of the 1920s in the US, when the average company would tend to either shut shop or exploit cheap labour, IBM actually provided jobs and life insurance—and even paid vacations!

And then, later, there was WWII: at that time (from the IBM archives), "all IBM facilities were placed at the disposal of the U.S. government. IBM's product line expanded to include bombsights, rifles and engine parts—in all, more than three dozen major ordnance items. Thomas Watson, Sr., set a nominal one percent profit on those products and used the money to establish a fund for widows and orphans of IBM war casualties."

For IBM's history, visit **www-03.ibm.com/ibm/history/**.

1931 / 1935:
The company introduced the IBM 601 in one of these two years, depending on whom you ask; it was a punch card machine with an arithmetic unit based on "relays." It could do a multiplication in one second. It read two numbers up to eight decimal places from a card and punched the result on a blank space on the same card.

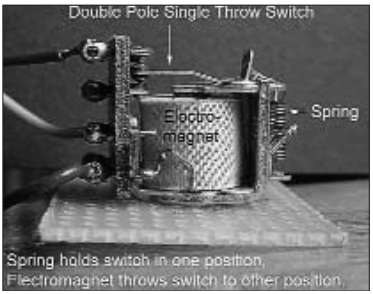
(A relay is an electrical switch that opens and closes under the control of another electrical circuit. Note that it is still "electrical," not "electronic.")

The machine became important in scientific as well as commercial computation, with several hundred units manufactured. Remember that computers or computing machines at the time weren't counted in the millions!

1.8 The Universe Opens Up

1937
Alan Mathison Turing of Cambridge published a paper on "computable numbers,' which was, essentially, the mathematical theo-

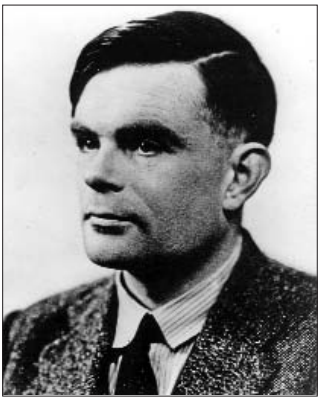
ry of computation. That paper solved a mathematical problem, but with a difference: the solution was derived not by mathematical calculations, but by *reasoning about the Turing machine*. The Turing Machine (TM) is a theoretical, simplified computer.



A basic relay. It is important, as you've gathered by now

That was it. Computer science was born. It should have correctly been called "computing science," according to some, but well.

For this, we must quote stanford.edu to some length. Our explanations are in parentheses.


The face of computer science: Alan Turing

"Turing, writing before the invention of the modern digital computer, was interested in the question of what it means to be computable (meaning, simply, can it be computed? For example, the problem of factorising a 20,000-digit number is computable; the problem of determining c given a + b + c = 20 and a = 3 is not!). Intuitively a task is computable if one can specify a sequence of instructions which when followed will result in the completion of the task. Such a set of instructions is called an effective procedure, or algorithm, for the task. This intuition must be made precise by defining the capabilities of the device that is to carry out the instructions. Devices with different capabilities may be able to complete different instruction sets, and therefore may result in different classes of computable tasks.

"Turing proposed a class of devices that came to be known as Turing machines.

"The proposition that Turing's notion (that class of devices) captures exactly the intuitive idea of effective procedure is called the Church-Turing thesis. This proposition, being a claim about the relationship between a formal concept and intuition, is not provable, though it would be refuted by an intuitively acceptable algorithm for a task that is not Turing-computable. That no such counterexample has been found, together with the fact that... indicates that there is at least something natural about this notion of computability.

"Turing machines are not physical objects but mathematical ones. The architecture is simply described, and the actions that may be carried out by the machine are simple and unambiguously specified. Turing recognized that it is not necessary to talk about how the machine carries out its actions, but merely to take as given the twin ideas that the machine can carry out the specified actions, and that those actions may be uniquely described."

The third paragraph might warrant explanation: what Turing proposed as his TM is the same as the (intuitive) idea that something *can* be computed. Now *this* cannot be proved right, of course, but still, if one were *able* to find an algorithm for a task that Turing said was *not* computable, then that algorithm would prove it *wrong*.

Anyone—absolutely anyone—interested in how our computers are Turing machines and how they came to be should visit **http://plato.stanford.edu/entries/turing-machine/**, which supplies an excellent introduction.

1937

George Stibitz of Bell Labs constructed a 1-bit ˜binary˜ adder using relays. This was, therefore, one of the first binary computers, although it was only a demonstration. Improvements led to the Complex Number Calculator of 1940.

1938

A graduate student at MIT, Claude Shannon, combined the binary system (which was first created by... Leibniz!) with Boolean algebra and published a paper on the implementation of symbolic logic using relays. It is hard at first glance to understand the importance of this.

Let us spell it out: with the new, proposed system, it would be possible to design digital computers!

It is beyond our scope here to explain symbolic logic; we'll just say the little that follows. Suppose you were to assign symbols to facts, such as, you assign "A" to "This is Digit", and "B" to "This is a newspaper". Then, both A *and* B being true would be "A ^ B"; either A or B being true would be "A v B". In this particular case, "A ^ B" is False, and the latter is True. Now note that this can be captured by Boolean algebra, as we explained it. And if *that* can be married to the binary system (here, relays)—then we have a "killer app" as we call it these days: logic over the wires! Logic and reasoning in transistors and chips and what-not! Which means—*machines can now act on information!*

Claude Shannon married bits to logic

To borrow from thocp.net, "In his paper, which was widely circulated, Shannon showed how Boole's concepts of TRUE and FALSE could be used to represent the functions of switches in electronic circuits. It is difficult to convey just how important this concept was; suffice it to say that Shannon had provided electronics engineers with the mathematical tool they needed to design digital electronic circuits, and these techniques remain the cornerstone of digital electronic design to this day."

For one view of Shannon's contributions, we have www.nyu.edu/pages/linguistics/courses/v610003/shan.html; for a biography, http://scienceworld.wolfram.com/biography/Shannon. html ; for an excellent overview of Shannon's work, www.ams.org/notices/200201/fea-shannon.pdf.

And as if all that weren't enough for one decade, we have...

1.9 Atanasoff And Zuse

1939

Dr John Vincent Atanasoff and graduate student Clifford Berry of Iowa State College (now Iowa State University) designed a prototype 16-bit adder. This was the first machine to *calculate* using vacuum tubes.

Summer Of 1941

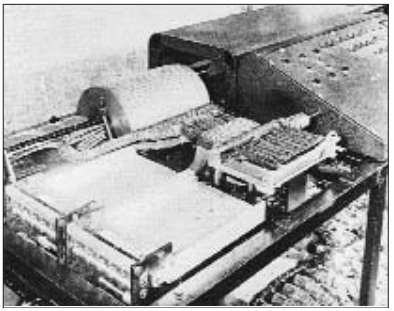
Atanasoff and Berry then completed a special-purpose calculator for solving simultaneous linear equations; this was later called the ABC (Atanasoff-Berry Computer). The clock speed was 60 Hz, and an addition took 1 second. For secondary memory—"hard disks", as we know them today—it used punch cards. The holes were not punched into the cards but burnt. For information on the ABC—if you can deal with a page that pitches Atanasoff as the Inventor of the "Real Computer"—there's www.intercom.net/local/ shore_journal/joc10225.html.

December 1941

With some backing from the Deutsche Versuchsanstalt für Luftfahrt (German Aeronautical Research Institute), Konrad Zuse, a name you cannot afford to forget, completed his V3 (later the Z3): *the first operational programmable calculator*. So what? Well, computermuseum.li states:

"Dr Zuse's Z3 Computer, designed and built from 1938 to 1941, was the first automatic, program-controlled, fully-functional, general purpose digital computer."

In other words, the first computer.


The Atanasoff-Berry Computer

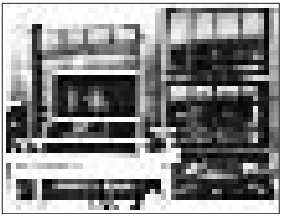
Debate rages as to which computer deserves to be called "The First Computer," but it's an idle one—because it's only a title, and a flippant one at that. The Harvard Mark I is one candidate; the ABC was never patented, but that is a candidate, too; and the ENIAC (which we'll talk about soon) is another contender. But take a look at this, from Time Magazine, in regards to who built the first computer (our italics): "*Even the Germans* made a *stab at computing* with Konrad Zuse's Z electromechanical computers, the last of which was the first general-purpose computer controlled by a program." It sidelines the Z3 completely. Well, the site we cited earlier overdoes it by calling the Z3 "automatic" and "fully-functional," but the Time article sidesteps the "general purpose." Well, Time is an American publications, so it's Americans all the way for them—take your pick! (Hint: if you play war games, your guess should be obvious.)


Konrad Zuse in 1992

However, Konrad Zuse's son, Prof Horst Zuse, has a Web site: **www.epemag.com/zuse/**. It's well worth a long look. (For example, Prof. Zuse points out that the ABC was a special purpose computer and was not freely programmable.)

The almost-definitive guide to all you need to know about Zuse is **http://ei.cs.vt.edu/~history/Zuse.html**.

1.10 Wartime 1943



The Z3 is the Desktop-like thing at the left; this is an actual photograph

January 1943

The Harvard Mark I, which was originally called the ASCC Mark I, Harvard-IBM Automatic Sequence Controlled Calculator, was built at Harvard University by Howard Aiken and his team. The project was partly financed by IBM. It is said that it became the first program-controlled calculator, though as we mentioned above, the Z3 lays claim to that, too. The machine weighed five tonnes.

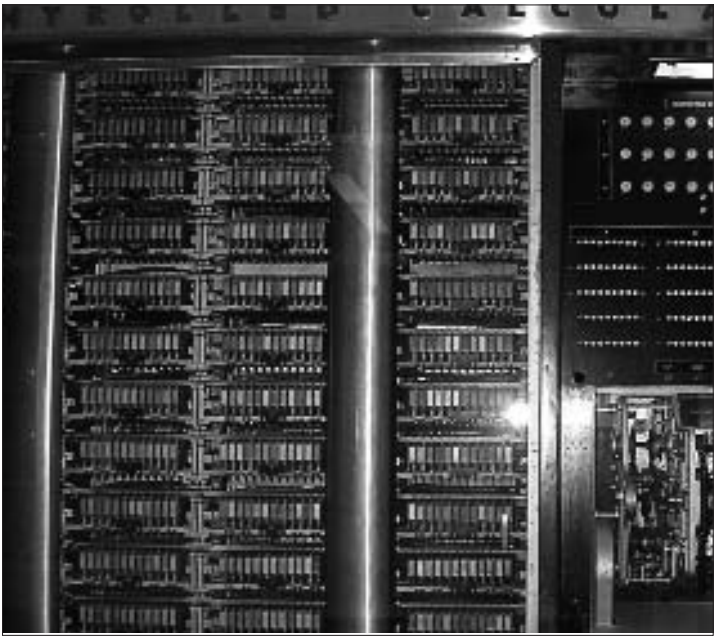
The program was read from a paper tape; data could be read from other tapes or card readers or the constant registers (refer chapter 2 for an explanation of registers). Later, the Mark I was modified to support multiple paper tape readers for the program. The transfer of the running program from one of the tapes to the other could be conditional, which meant it supported a conditional subroutine call. (Non-programmers, skip!)

Howard Aiken, the computer icon that side of the Atlantic

On maxmon.com is this interesting snippet: "Many consider that the modern computer era commenced with the first large-scale automatic digital computer, which was developed between 1939 and 1944 (see also Konrad Zuse and his Z3 computer)." This underscores the fact that both are strong contenders to the throne of "first computer," but the idea is, the Mark I was large-scale.

Visit **http://tinyurl.com/2w4zav** for IBM's perspective of the Mark I.

Sometime later in 1943 began Project Whirlwind, to design a flight simulator for bombing crews. It was completed in the 50s.



A portion of the Harvard Mark I

April 1943

Codes are used in war; in this war, it was about electronic ciphers.

Max Newman, C E Wynn-Williams, and their team—which included Alan Turing—completed the "Heath Robinson." This operation was at the secret Government Code and Cypher School, Bletchley Park, Bletchley, England. The Heath Robinson was a specialised machine for cipher-breaking. It read data optically at 2,000 characters per second from two closed loops of paper tape, each about a thousand characters long. We mention this because it was the forerunner of the Colossus...

December 1943

The Colossus, another, more powerful cipher-breaking computer, was built by Dr Thomas Flowers at The Post Office Research

Laboratories in London to crack the Lorenz Cipher used by the German "Enigma" machines. It was used at Bletchley Park during WWII, as a successor to the Heath Robinsons. It translated 5,000 characters per second (compare with 2,000 above), and used punched tape for input. Ten of these machines were built, but they were destroyed right after their work was done: the thing was so advanced, Britain didn't want its design falling into hostile hands.

And for all things code-breaking- and Bletchley Park-related, there's **www.turing.org.uk/turing/scrapbook/ww2.html** and **http://www.codesandciphers .org.uk/virtualbp/bpnow.htm**, not-so-coincidentally both .uk sites!

The Colossus was, well, colo...!

1.11 Three E-ACs And A Transistor

1946

The ENIAC (Electronic Numerical Integrator and Computer) was one of the first (a) totally-electronic, (b) valve-driven, and (c) digital computers. Development finished in 1946 at the Ballistic Research Laboratory in the USL it was designed by J Presper Eckert and John Mauchly. (Eckert was the brains, and Mauchly was the engineer, roughly speaking.) Yet another first, this one was widely recognised as the first Universal Electronic Computer. It weighed 30 tonnes, and could handle 1,00,000 calculations per second.

It was not used for entirely benign purposes: the numbers it crunched were those of ballistic trajectories and tests of hydrogen bomb theories.

1947

This was it—the invention of the century, indeed, no invention has surpassed this one to date. On 16 December, 1947, at The Bell Laboratories, William Shockley (first credit), John Bardeen, and Walter Brattain invented the transistor.

John Mauchly (far left) and J Presper Eckert (far right) with Maj. Gen. Barnes, head of research and development for the army ordnance, reviewing the ENIAC maintenance records. Yes, computers were a big deal back then!

We've explained in *Digit* how this three-legged marvel does its job, and how the silicon in it is being replaced by carbon nanotubes; suffice it now to say that much of your life depends on it!

William Bradford Shockley was a controversial figure: he was racist, he wanted all the fame (around the transistor) to himself,

he supported the idea of eugenics, and so on. However, personal follies must bow before intellectual greatness: he was awarded the Nobel Prize for physics in 1956.

Intel today produces billions upon billions of transistors every *day*, but those three earned very little. One-hundredth of a paisa per transistor in royalties would have meant...

1948

The SSEM (Small Scale Experimental Machine) was built at Manchester University, based on ideas from John von Neumann, a Hungarian Mathematician, about stored-program computers. All modern computers use the von Neumann architecture, as it is called; find out more in chapter 2. Essentially, this was the first computer ever to store both programs and data in memory!

Shockley (seated), and Bardeen and Brattain, in 1947

1949

Another first, but a *relatively* minor one: Maurice Wilkes and his team at Cambridge University build a computer called the EDSAC. It used paper tape for input and output, but it was the first stored-program computer that operated a regular computing service.

Proposed in 1949 by John von Neumann and completed in 1952 at the Institute for Advanced Study, Princeton, the EDVAC (Electronic Discrete Variable Computer) was the first computer to use magnetic tape. A breakthrough of sorts, because earlier computers could only be reprogrammed by re-wiring them! The EDVAC gave users the luxury of loading new programs off the tape.

1.12 Two Cs

1948

Norbert Wiener, who had been a BA in maths at age 14, published "Cybernetics," a major influence on later research into AI.

In addition to this, Wiener is noted for such things as his analysis of brain waves, and his exploration of how similar (or dissimilar) the human brain and the computer are—in terms of memory, decision-making, and so on.

For more on cybernetics, which happens to be an important field all its own, visit **http://pespmc1.vub.ac.be/ASC/CYBERNETICS.html**, which has plenty of links.

In addition Think "architecture," think John von Neumann

Also in 1948, Claude Shannon's *The Mathematical Theory of Communication* demonstrated to engineers how to code data such that they could check for accuracy after inter-computer transmission. The bytes weren't there, but the bits were, by this time, and it was now formalised: Shannon identified the bit as the fundamental unit of data. He also (but this happens to be coincidental!) identified it as the basic unit of computation.

This is no particular end-point, but we continue our journey from here into the 50s and on. But most of the foundations had been laid for the computer as we know it: vacuum tubes, then transistors; symbolic logic as bits; computer science; the first few computers.

Z4 To IC

The end of World War II saw an explosion of computing-related activity. Spin-offs from military related projects like the breaking of German communication codes and calculations of ballistic trajectories contributed to existing knowledge of how to execute complicated calculations. There were hiccups, but from that point onwards, the world was destined to be dragged, kicking and screaming, into the age of computers.

1950
The Turing Test

July: Zuse's Z4

Konrad Zuse, whom we've mentioned in chapter 1, leased his Z4 computer in July to the ETH Zurich, a well-known university, making the Z4 the first commercial computer. Zuse, in addition to his computers, including the Z3, also designed the first high-level programming language, the Plankalkül, and founded the first "computer start-up."

The Evolution Of Code

Programming languages are divided mainly into two types—low-level and high-level, depending on the level of abstraction. Roughly speaking, low-level languages, like assembly language, speak to the processor more directly—they address the actual hardware: registers, memory locations, and so on. High-level languages (C, C++, Java, etc.) refer to abstract elements like variables, arrays, and Boolean expressions. High-level languages are used to write easy-to-understand code; low-level languages for writing more efficient code.

October: The Turing Test

Alan Turing introduced the "Turing Test" in his paper titled "Computing Machinery and Intelligence." In simple terms, if a human judge cannot distinguish between a computer and another human while interacting with them, the computer is said to have passed the Turing Test. Turing predicted that by 2000, computers would pass the Test. There have been various programs that have demonstrated some amount of humanlike behaviour, but no computer has thus far passed the Turing Test.

1951
The Coming Of Interactivity

March: UNIVAC I

The UNIVAC I (UNIVersal Automatic Computer), the first commercial multi-purpose computer, was delivered by Remington Rand to the US Census Bureau. Eckert and Mauchly, who we've mentioned in chapter 1, were the moving force behind it. The machine cost about $1 million (Rs 3.6 crore now) to build, weighed 13 tons, and was as big as an one-car garage. The clock speed was 2.25 MHz, and the main I/O devices were magnetic tape and punch-cards. About 46 were built, most of them for US governmental agencies, and some for big corporations like Westinghouse, General Electric and DuPont. The last UNIVAC remained in service till 1970 with Life and Casualty of Tennessee, an insurance company.

The rather large, 2.25 MHz UNIVAC

Going Shopping

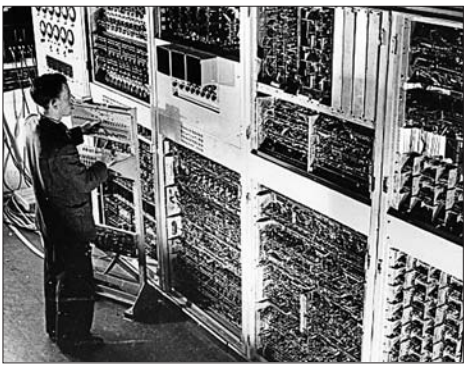
A UNIVAC was very difficult to maintain, so most customers did not have it shipped; they worked on them at the location where they were built. In fact, the first computer that was installed on location was at the Pentagon for the US Air Force in June 1952.

April: Interactivity!

The Whirlwind, the first interactive computer that worked in real-time, was unveiled at MIT in April. Real-time interactivity means the time lag between your instruction and the response from the computer is barely noticeable—in the order of milliseconds. Before

the Whirlwind, computers worked in batch mode—you keyed in instructions, went out for a stroll, and got back to find the results printed out. But the Whirlwind, originally intended as a flight simulator for US Navy bomber crews, could not have functioned in this way. Jay Forrester and his team at MIT's Lincoln Labs decided to use core memory (where magnetic ceramic rings are employed) as storage; this made the computer faster. It was also the first time video was used as an output device, in the form of a giant oscilloscope screen. Later versions were used as a backbone of SAGE, the air defence system of the US Air Force and also the first computer network. In 1956, a keyboard was integrated into the system.

August: Computer Music


A part of the CSIRAC computer

CSIRAC (Council for Scientific and Industrial Research Association Computer), which started functioning in Sydney in 1949, became the first computer ever to play music during its first public exhibition. Upon inserting a punch card on which music was written in the standard notation, the computer would play it back through its loudspeaker. It was pretty crude, but still quite innovative in the early fifties.

November: Business Apps

LEO I (Lyons Electronic Office I) became was the first computer to run a business application. The computer was modelled on the Cambridge EDSAC, which was supported in part by J Lyons and Company, one of the UK's leading catering and food manufacturing companies. The LEO I was used for business data processing like inventory, payroll, costing, and delivery schedules—both in-

house for J Lyons and later for other companies like Ford UK. A later model, the LEO III, completed in 1961 used core memory and employed concurrent programming—running as many as 16 applications simultaneously. The LEO III remained in service until 1981 with British Telecom.


Grace Hopper at a UNIVAC-1 console

1952
The Compiler

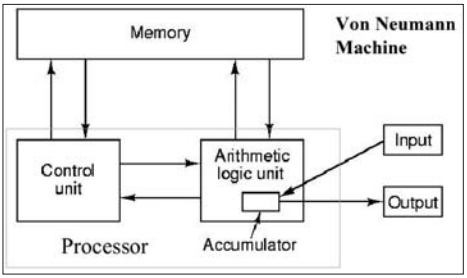
June: A general-purpose, von Neumann computer

The IAS General Purpose Computer was completed by von Neumann and his team at the Institute of Advanced Studies, Princeton. Work on the IAS started around 1946 and the project had a budget of several hundred thousand dollars (in the order of a crore of rupees

Founding Father

John von Neumann, a Hungarian mathematician (who took American citizenship), was one of the greatest mathematicians in history. He made outstanding contributions in numerous areas of physics, mathematics, economics, and computer science. Among other things he is known for the computer architecture which bears his name—a control unit, an arithmetic and logical unit, memory, and I/O. The von Neumann architecture is at the heart of the design of all modern-day computers—from handhelds to supercomputers. An alternative architecture, known as the Harvard architecture, where the instructions and data are separately stored, is used in some components (digital signal processors used in audio or video signal processing). These types of machines can read data and instructions simultaneously, unlike von Neumann machines.

now). It was built on the design principles of what were later known as the von Neumann architecture. The first machine at Princeton served as a template for computers that were optimised for mathematical and scientific calculations in such fields as astronomy, meteorology, and hydrodynamics. These computers were used, for instance, in Los Alamos for computations that led to the design of the hydrogen bomb. Most of these computers were present in universities and research organisations; they were not designed for business users.



The now-obvious von Neumann architecture

King Me

Arthur Samuels at IBM wrote the first game-playing program for checkers that was sufficiently skilled to play with a world champion. In 1955, the Samuel Checkers-playing program was the first program that learnt how to play, a significant milestone in the annals of AI.

November: Computer prediction

The UNIVAC cemented its place in the public mind-space when it correctly predicted the winner of the presidential poll in November between Dwight D Eisenhower and Adlai Stevenson. The expert opinion favoured a close race, while a UNIVAC borrowed by CBS predicted that Eisenhower would win by a landslide. CBS did not immediately release the results, but when the actual vote count came later, had to admit that the UNIVAC had only a 3 per cent margin of error. The term "Univac" became a generic name for computers; the 1953 IBM 701 was called IBM's Univac.

November: The compiler

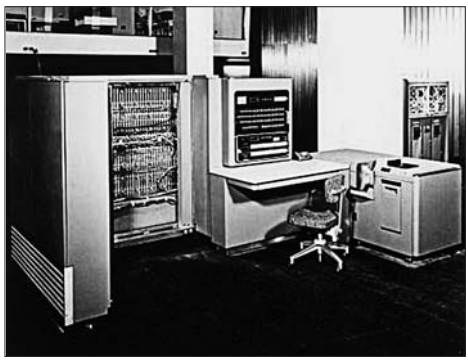
Rear Admiral Dr Grace Hopper, a pioneer in programming invented the first ever compiler—for the UNIVAC I, the A-O. She

was associated with the UNIVAC team along with Eckert and Mauchly. Later versions like ARITH-MATIC, MATH-MATIC and FLOW-MATIC were released, and were used for business and scientific data processing.

1953
Transistorisation!

April: The 701

IBM unveiled the IBM 701, its first mass-produced computer for scientific use. It was significant in other aspects too; IBM had ventured from its core business of making punch card machines to making electronic computers. The 701 also launched the IBM 700 series—702, 704, 705, and 709 which spanned the 1950s. Known as the Defense Calculator in the developmental stage, it stored data using a Williams-Kilburn tube (a type of cathode ray tube). The 701 used assembly language; from the 704 (completed in 1954) onwards, FORTRAN, invented by John Backus at IBM, was used as the programming language. The 701 was the first computer to demonstrate artificial intelligence by running a Samuel checkers-playing program.



The IBM 701, also known as the Defense Calculator

November: A transistorised computer

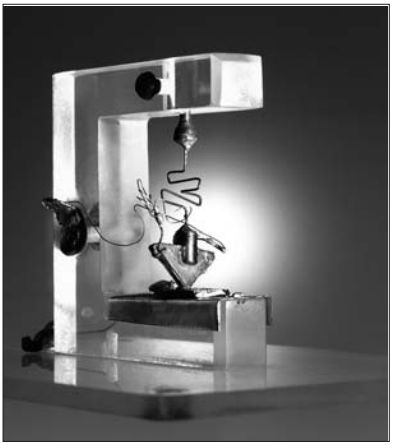
A small computer was built using transistors—the first time vacuum tubes were not used in a computer. Built by Richard Grimsdale and Doug Webb at the University of Manchester, it

used 92 transistors. This prototype later became the MV950, the first commercial transistorised computer and was built in 1959. Seven MV950s were sold.

1954
Silicon And Supercomputers

April: Silicon!

Gordon Teal of Texas Instrument's Semiconductor R&D announced at a Radio Engineers convention that silicon-based junction transistors were in commercial production. As the story goes, Teal was one of the last speakers, and general opinion was that it would take some years to perfect a silicon transistor. When Teal announced that Texas Instruments had perfected the silicon transistor, he dipped the germanium transistors of the amplifier of a record player in hot oil. The music died out (the transistors could not tolerate the heat). Next, he dipped the same rig, outfitted with silicon transistors, in hot oil. The music played on; the silicon age had well and truly arrived.



The first ever transistor looked like... *this!*

Summer of 54: FORTRAN is born

Development work on FORTRAN (FORmula TRANslator) started at IBM. It was the first popular high-level language and is still in use. The first version was completed in 1957; later revisions, most notably in 1977 and 1990, have ensured that the language retained some relevancy in the modern era (concepts like object oriented programming, arrays, and generic programming were added

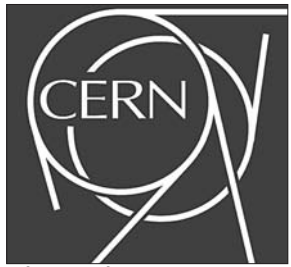
later). FORTRAN was written for the IBM 704 by a team led by John Backus (one of the inventors of the Backus-Naur Form). It was long the language of choice for the scientific and engineering community, with applications in many areas like weather forecasting, computational fluid dynamics, quantum chromodynamics, and other tasks where supercomputers are used. Some benchmarks for computer processors are still written in FORTRAN. The language is scheduled for another revision in 2008.

Ancient Computing?

The Backus Naur form is a formal method of defining the structure of languages, especially computer languages. It has many similarities to Panini's rules for Sanskrit grammar. It was first introduced in 1959.

September: CERN established

CERN (European Organisation for Nuclear Research, French: Organisation européenne pour la recherche nucléaire) was established in September by 12 European states. It was dedicated to nuclear research and particle physics, though later on it had important influences in the world of computing. It was a pioneer in introducing the Internet to Europe in the 1980s, while the World Wide Web was the result of a CERN project in 1991.



The CERN logo

December: The first commercial mass-produced computer

The IBM 650, also known as the Magnetic Drum Calculator, was released. It was the first mass-produced computer designed for commercial use. In nine years of manufacture, IBM sold 2,000 650s. It used magnetic drum memory for storage, and was compatible with punch card readers. The 650 used a table look-up feature, along with error checking capabilities, which made it suitable for insurance companies, public utility companies, and transport companies to calculate bills. It was the most popular computer of the 1950s.

The digital logic unit of the NORC

The console unit of the IBM 650

December: The first "supercomputer"

The NORC (Naval Ordnance Research Calculator) was delivered to the US Navy. It was the first computer to have been called a supercomputer; it could perform 15,000 arithmetical calculations in one second. Its first demonstration was to calculate the value of pi, which it calculated to an accuracy of 3,089 digits, a record at that time. The NORC was used for complicated operations like calculation of missile trajectories and plotting the orbits earth and other

A Bit About Supercomputers

Supercomputers are giant computers, both in size and processing power. They are used for tasks that require extensive processing capabilities like weather forecasting, analysis of geological data for petroleum processing, molecular modelling, nuclear energy research, and cryptanalysis. Supercomputers today measure their speed in TeraFLOPS (trillions of floating point operations per second), with the fastest supercomputer as of June 2007 being BlueGene/L, with a speed of 280.6 teraflops. Seymour Cray's series of supercomputers are the best known, though IBM and HP are among the other makers. India's PARAM series, built by CDAC, is our home-grown supercomputers; PARAM 10000 is at 1 teraflop, while CDAC plans to build a 1 PetaFLOP (1,000 trillion FLOPS) unit in 2010.

heavenly bodies. All these computations required billions of calculations, taking hundreds of factors into account, and were not possible using other computers of that era.

1955
User Groups

January: Fully transistorised

The TRADIC (TRAnsistor DIgital Computer) was the first fully-transistorised computer; it was built by Bell Labs for the US Air Force. It had 700 transistors and 10,000 germanium diodes. A small and light system, TRADIC was installed on a B-52 Stratofortress bomber and consumed only 100 watts, a far cry from its giant vacuum tube contemporaries. It was also comparable in speed, performing about a million logical operations in one second.

August: SHARE, a user group that's still around

SHARE, the oldest and still-functioning computer user group was founded by the aerospace industry users of IBM mainframes. User groups, formed initially to share information about software and best uses, later morphed into what is known as communities. User groups—Linux User Groups, for example—have been the driving force in the implementation and adoption of new technologies.

1956
Disk Storage

January: The Stretch—all about speed

The Stretch project, which eventually became IBM 7030—a second generation mainframe computer—was started. The aim of the project was to build a computer a hundred times faster than the 704, though actual performance was only 30x. It was a transistorised supercomputer intended for use by scientists. Construction began in 1959, and the first computer was delivered in 1961, a year behind schedule. Though the Stretch was not very successful


The console of the IBM Stretch

financially or technically, its architecture influenced future designs in areas of core memory, transistor circuits, and circuit packaging. The Stretch computers were the fastest until 1964 and they led the basis for the runaway success of IBM's System/360.

April: The Whirlpool "is transistorised"

The TX-0 (Transistorized Experimental zero) computer was built at MIT. It was essentially a transistorised version of the Whirlpool computer. It was only intended for experimental purposes, though the original design was the basis for the PDP-1 computers made by DEC in 1961.

July: "AI", the word

John McCarthy coined the term "Artificial Intelligence"; Allen Newell, J C Shaw and Herbert Simon introduced the Logic Theorist, the first program to demonstrate artificial intelligence. It was used to find the basic equations of logic as defined in the Principia Mathematica, a treatise on mathematics. It could solve most of the theorems in the same way a human would solve, and in one case even managed a more elegant proof.


John McCarthy, the Father of Artificial Intelligence

August: An easy-to-use computer

The Bendix G-15 computer was introduced by the Bendix Corporation. It was easy to use; the operator did not need special training. It was also comparatively cheaper (you could get a G-15 for $60,000 (Rs 3.2 crore now) or rent out one for about $1,500 (Rs 8 lakh now) per month). This enabled smaller companies to use the system. The G-15's dimensions were 5 x 3 x 3 feet and it weighed 450 kg. The system was built mainly for scientific and industrial users.

September: Disk storage

The IBM 305 RAMAC (Random Access Method of Accounting and Control), the first computer to use magnetic disk drives for secondary storage instead of electrostatic tubes or magnetic drums was introduced. It was also one of the last vacuum tube computers; later models would be solid-state. The capacity of the 305 was 5 million characters, which were stored on 50 24-inch aluminium disks coated with magnetic iron oxide. The disks ran at 1,200 rpm, and the distance between the read head and the disk surface was 800 micro-inches (modern drives have a distance of less than 3 micro-inches). The system was available for $160,000 (Rs 8.6 crore now) though buyers had the option of leasing it for $3,200 (Rs 17 lakh now) per month. About 1,000 systems were built before production ended in 1961.

A platter of the IBM 305 RAMAC's hard disk

Tech In Sport

The 305 RAMAC was used in the 1960 Winter Olympics to handle the first electronic data processing system

1957
Fairchild And DEC

May: Fairchild is established

Fairchild Semiconductor was established in May of 1957 to develop silicon-based semiconductors. Composed of a nucleus of eight engineers (Robert Noyce and Gordon Moore, Intel's founders, were two of them), the company has many pioneering advances in transistor technology to its credit—the planar process, which made transistors cheaper to make and more reliable, op-amps, and circuits for Cray supercomputers. Fairchild is a publicly-traded company and now specialises in products for optimising system power.

June: A calculator made only of electronic circuits

Casio, a Japanese company founded in 1946, released the Model 14-A, the first all-electric compact relay calculator (which in plain language means electronic circuits!). Early calculators used gears and were operated by cranks or motors. Casio's calculator, apart from being electronic, used a ten-button keypad instead of individual keys for individual numbers and a single display pane. Casio Computers Company Ltd. was also founded, and the firm is a major manufacturer of calculators, PDAs, watches, cameras, and audio equipment.

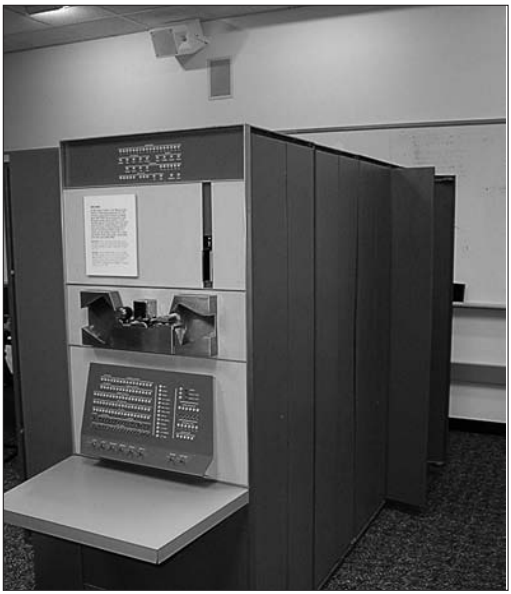
Summer of '57: An AI problem solver

The General Problem Solver was invented by Herbert Simon and Alan Newell in the as an artificially intelligent "universal problem solver." Theoretically, the General Problem Solver could solve any problem that could be put into a formal notation. Though it could solve some problems in computer theory like the "Towers of Hanoi," it was unsuccessful at solving abstract real-life problems.

August: DEC is founded

Digital Equipment Corp. (DEC) was founded in August by Ken Olsen and Harlan Anderson, two engineers working on the TX-2 computer project at MIT. Its early products included electronic components like flip-flops and gates. It later on built complete

minicomputers in the PDP and the VAX series, which were much in use among scientists and engineers in the 1970s and 1980s. Some notable products from the DEC stables included the PDP-8 (in 1963, which was the first minicomputer), the PDP- 11(which supported the then-new UNIX), and the VAX (the first 32-bit minicomputer). It was also largely influential in making the Ethernet standard commercially successful. In the 1980s it lost out to newer competitors and was ultimately sold out to Compaq.



The PDP-1 microcomputer (a front-right side view)

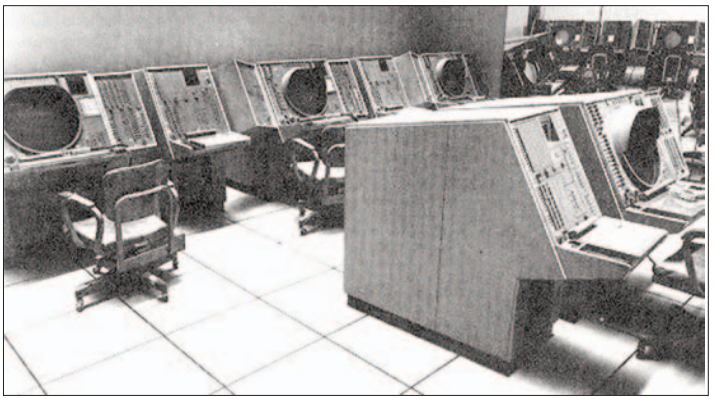
Enlarge Your...

The first spam message was sent by a DEC employee in 1979 over the ARPANET. About 400 people received the message.

The Not-so-mini Mini

The minicomputer is a now-obsolete class of computer, which was positioned between mainframes and personal computers. This class, which evolved in the 60s, had its own hardware and operating systems, though computers in the class were just bigger and more powerful versions of the personal computer. This category died out in the 1980s with the advent of cheaper and more powerful hardware.

1958
The IC Arrives



A part of the SAGE A/N FSQ -7

January: A computerised network for defence

SAGE (Semi Automatic Ground Environment), the first computerised air defence network, was set up in the United States. SAGE was conceived to provide an early warning against incoming long-range Soviet bombers. The SAGE centres were connected by telephone lines, and each was built around the IBM's A/N FSQ-7 computer, which incidentally is the largest (it weighed 275 tons and occupied half an acre) computer ever built. The A/N FSQ-7 was based on MIT's Whirlwind II. By the time SAGE was completed in 1963, it was practically redundant as the Soviet Union deployed ICBMs as the primary long range delivery platform for nuclear weapons. However, the engineering effort behind the project was huge and the experience gained in systems integration was vital when the ARPANET was later built. SAGE was dismantled in 1983.

February: And DARPA is established

DARPA (Defence Advanced Research Projects Agency) was established in February. Its mission was to conduct R&D into futuristic technologies. Its creation was hastened by the Sputnik launch; the

US felt it was lagging behind the Soviet Union in military research. DARPA's research projects have not been confined to the military sphere: the concepts of networking and the Internet, hypertext, and GPS are some of its project spin-offs. Douglas Engelbart, the inventor of the mouse, was associated with DARPA.

April: Japan uses the parametron for its first computer

The NEAC 1101, Japan's first computer, was built by NEC as a prototype. It was a parametron-based computer, the parametron being a cheap component, though slower than the transistor. The NEAC 1101 was designed for scientific and engineering use and was the first Japanese computer to use floating point operations. This computer was instrumental in development of NEC's later parametron computers.

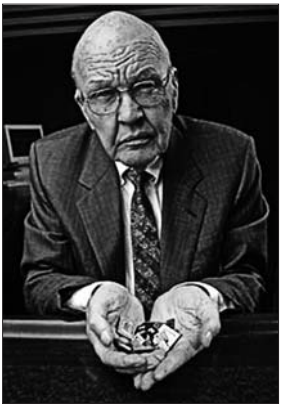
May / June: ALGOL, rather an important language

ALGOL (ALGOrithmic Language), an important computer language, was developed by a group of American and European computer scientists at Zurich. It was introduced to deal with some of the problems faced while working with FORTRAN and was used mainly by the scientific community. Later revisions, notably in 1960, were influential in the development of almost all future computer languages—and also led directly to the development of Pascal, a language that was used for introducing students to programming.

September: The Integrated Circuit

Jack Kilby at Texas Instruments invented the Integrated Circuit in September 1958, an invention that opened the doors to the digital age. Electronic circuits prior to the IC consisted of capacitors, transistors, resistors, and many other components individually connected by wires. Such designs occupied a lot of space and were unreliable. In the IC, every component is made of silicon, actually an extension of a tiny silicon wafer and connected by almost invisible wires. The whole set up consumes very low power, is cheap to manufacture and is very small (modern ICs pack about 1 million transistors per square millimetre). The IC is at the heart of any-


A modern-day chip


Jack Kilby, the Father of the Integrated Circuit

thing electronic from wristwatches to space shuttles. At about the same time as Kilby, Robert Noyce of Fairchild Semiconductor independently invented another method of IC fabrication. These innovations have contributed to a market that is worth more than $1 trillion today (Rs 41 lakh crore) and growing. Kilby received the 2000 Nobel Prize in Physics for his work.

Summer Of '58: LISP, the language of AI

LISP was invented by John McCarthy, the father of AI, and implemented on an IBM 704 computer. It is, after FORTRAN, the second-oldest high level language in use. It found use in AI research and pioneered many new concepts like tree data structures, object oriented programming, and dynamic typing. Linked lists were a major innovation; in fact, "LISP" comes from "List Processor." LISP has seen many ups and downs, though there has been a flurry of activity in recent years related to open source implementation of portable libraries and applications. The first LISP complier was completed in 1962; it was written in LISP.

October: NASA gets off the ground...

NASA (National Aeronautics and Space Administration) began operations; it was at the forefront of developing technologies in every sphere related to the US space programme. In the early days,

this meant the use of analogue computers in Project Mercury (exploring the possibility of human flight to space) and digital computers for later programs like Apollo (lunar missions) as simulators, which were the primary means of training astronauts. Apart from training, computers were used for guidance, for communications with crews, and also for controlling all aspects of space craft behaviour—right from fine-tuning orbit speeds to recycling water and oxygen. Spin-offs from the space programme include communication technologies, semiconductor fabrication, virtual reality, keyboard designs, optical discs, and more.

1959
COBOL And Automation

Early 1959: Automated cheque-reading

The ERMA (Electronic Recording Machine, Accounting) system was installed at the Bank of America to automate the reading of cheques. Cheques were numbered using magnetic ink, which were read by a magnetic reader. The computer, which used both vacuum tubes and diodes and had more than a million feet in wiring, could read 10 cheques per second. The use of the ERMAs made Bank of America the market leader in its sector.

April: The MIT Artificial Intelligence Laboratory

The Artificial Intelligence Laboratory was set up at MIT by AI pioneers John McCarthy and Marvin Minsky. (The latter is known for his contributions to computational linguistics, optics, and robotics). It was a leading centre for research in AI, robotics, language, problems of vision, and mechanical manipulation. Richard Stallman, the free software activist, was one of the programmers who worked there.

Marvin Minsky, one of the pioneers of AI

May: COBOL

COBOL (COmmon Business Oriented Language), one of the oldest languages still in use, was created by a committee of industry

representatives at a meeting held in the Pentagon. The language was intended for use in business and government and has a cumbersome syntax, though programs written in it are easy to modify. It was based on Grace Hopper's FLOWMATIC, which is also known as the "mother of COBOL" and also on IBM's COMTRAN. The first compiler was developed in 1961, and usage exploded. COBOL It was estimated that in 1997, 80 per cent of businesses all over the world ran on COBOL, with 180 billion lines of code in existence and five billion lines added annually. The last COBOL revision was in 2002.

August: Panasonic, which brought us VHS

Panasonic was founded as Matsushita Electric Corporation of America. It started by manufacturing audio equipment. It is a competitor of Sony and Hitachi and was locked in a fierce fight with Sony over videotape formats in the late 70s. (VHS, supported by Panasonic, ultimately pushed over the Sony-backed Betamax. VHS gave more recording time and faster rewind and fast forward rates than Betamax.) It is one of the largest manufacturers of consumer electronics. Panasonic is still called Matsushita in Japan.

October: IBM's 1400 series

IBM launched the 1400 series for business users. This series of computers was the second-generation transistorised machines, which could be operated either independently, with IBM's punch card equipment, or with other computers. The line remained in production until the early 1970s.

Compared to the present day, the '50s were anything but exciting. People wrestled with bulky radios and the ledger was the most reliable way of keeping records. But seeds of advances that dazzled the world in later years were sown in the '50s, the prime examples being the silicon chip and the IC.

The Decade Of Networking

This decade was witness to two events that had a significant influence on computers—the space race and the cold war. The successful launch of the first human satellite, Sputnik, by the USSR, is considered the start of a race to be the first nation to put a man on the moon; and there was the cold war, which had precipitated the Cuban missile crisis. These were events that spurred the US government to channel significant investment into research and development on technologies related to electronics and computing.

1960
Programming And Neural Networks

June: Neural Networks

The Perceptron, also known as the MARK 1, built by Frank Rosenblatt at Cornell University, was a computer that could learn by trial an error, which was also the first time artificial neural networks were used in computing. It was built on an IBM 704.

July: Compiler Compilers

The first compiler compiler was written by Tony Brooker at the University of Manchester. Compiler compilers, also known as parser generators, are used to derive the source code of a parser, interpreter or compiler where the input is the grammar of the language. Even if you don't know what the above means, suffice it to say that without compiler compilers, it would be impossible to develop compilers for any language, and consequently impossible to write programs. YACC (Yet Another Compiler Compiler) is a typical example of one.

Communications Standards

The RS-232 communication standard was unveiled. This standard governs how binary data signals are transferred between serial ports in computers. Such standards have undergone numerous revisions over the years.

1961
Time-sharing—The Concept

February: The First Computer Game

Spacewar! was conceived by MIT students Martin Graetz, Stephen Russell, and Wayne Witanen. It was completed in 1962. It is considered the first computer game. It was first run on the PDP-1, a minicomputer. It was a simple two-player game that involved two spaceships trying to destroy each other by "firing" projectiles. The position and angle of the space ships could be altered with consoles. The game was character based.

Teach Me Master

Artificial neural networks mimic biological learning behaviour. These are composed of simple processing elements called neurons, which display dynamic behaviour based on the information that passes through the network. A rough example: a neural-network might be able to tell the parts of speech of a sentence given lots of sample sentences and their parts of speech. It would be able to do this because it can "get" analogies, unlike systems that are hard-coded into saying that the result is either this or that.

April: The IC Is Patented—Noyce Gets It

The Integrated Circuit (IC), invented in 1958, was patented. Both (independent) inventors applied for the patent—Kilby from Texas Instruments, who called it "Solid Circuit," and Noyce from Fairchild Semiconductor, who called it "Unitary Circuit." The patent was awarded to the latter. The term "chip," used for an IC, is derived from the single piece of silicon holding the circuit. The first chip contained one transistor, one capacitor, and three resistors. Thanks to the space-saving nature of the invention, ICs rapidly gained in popularity and contributed to the reduction in sizes of many components.

April: The High-performance Stretch

IBM delivered the "Stretch" 7030 computer to Los Alamos Scientific Laboratories, which was at the forefront of US Nuclear weapons research. Stretch was the codename for the high-performance computers manufactured by IBM starting with the 7030. Its use of eight-bit bytes popularised the concept at a time when byte size was subjective.

June: Pioneering Work In Hard Disks

The IBM 1301 Disk Drive was introduced. It pioneered many concepts still in use in today's hard disks, like individual read/write heads for each platter, the cylinder concept, sliding movement of heads, etc. The 1310 had a spindle speed of 1800 rpm and a storage capacity of 28 million characters.

October: The Desktop Electronic Calculator

The first desktop electronic calculator, ANITA ("A New Inspiration To Accounting" or "A New Inspiration To Arithmetic") was

launched. Created by Sumlock-Comptometer Ltd, it was first available in Britain. It used vacuum tubes and could perform the four basic arithmetic operations with a 8-digit input limit .

Anita made your tax calculations easier

November: Time-sharing

The Compatible Time Sharing System (CTSS) was created by Fernando Corbato. This allowed an entirely different means of interacting with a computer, which till then would operate in batch mode and could not be interrupted till all the steps of one batch were complete. Time-sharing enabled a computer to serve many users simultaneously. A time-sharing computer stops a job, transfers the relevant data to a different location, runs something else, and then resumes the previous job, thereby sharing the computer's processing time between all users. (It is worthwhile to remember that the reference to a computer in 1961 usually means a mainframe computer, which usually serves many users.) This also made the computer more interactive, since it could now respond to users' commands almost instantaneously. (Present-day computers also use concepts of the CTSS in the form of "interrupts," which allows a PC to multitask.) The CTSS led to the Advanced Research Projects Agency (ARPA)-funded project to create a full-fledged time-sharing system, named the Multiplexed Information and Computer System, or Multics.

The DBMS

The first database management system was created by Charles Bachman to support GE's manufacturing information system. The Integrated Data Store (IDS) database management system was the code of the system. It has many firsts to its credit : the first disk-based DBMS, at a time when punch cards were in vogue; the concept of "virtual memory" to differentially store permanent and dynamic data; and it also used a buffer to store recently-accessed data.

Neural Networks In Computing

The Perceptron, also known as MARK 1, built by Frank Rosenblatt at Cornell University was a computer that could learn by trial an error, which was also the first time artificial neural networks were used in computing. It was built on an IBM 704.

Robots In Manufacturing

The first robotic manufacturing device was created by Unimation (now Westinghouse). The brainchild of Joe Engelberger and George Devol, the Unimate was used to automate manufacturing TV tubes, and later used in General Motors' automobile factory to handle hot metal parts. It followed instructions stored on a magnetic drum.

1962
Packet Switching Comes In

January: A Programming Language Landmark

APL (A Programming Language) was developed by Ken Iverson. Considered a unique programming language with many eccentricities, it was intended to be a teaching tool for mathematics. Unique features included the lack of any English words as commands, including "if"; use of special characters that were not part of the regular keyboard, like Greek characters; and evaluating expressions from right to left. With unique language notations, APL allowed programs to be written with the fewest possible lines of code.

March: One More Small Computer

The LINC (Laboratory Instrumentation Computer) was created. Designed by Wesley Clark and Charlie Molnar, and assembled by the users themselves after the necessary training in programming and assembly, using modules made by Digital Equipment Corp., it was intended for real-time laboratory data processing. Unlike most computers of its day, the LINC was small enough to be accommodated on a lab table, it also sported a proper keypad, a 256 x 256 CRT display, a graphical user interface, and four knobs that pro-

vided the functionality of a mouse. Thanks to its size and user-friendliness, it is generally considered the first personal computer by many, including the IEEE Computer Society (one among 40 technical societies of the IEEE).


The LINC was the first non-massive PC

July: TV Across The Ocean

The Telstar communications satellite was launched, and relayed the first transatlantic television broadcast. The ground stations were based in the US, France, and Britain. An AT&T project that did not have any government aid, the Telstar programme estimated that "a system of 40 satellites in polar orbits and 15 in equatorial orbits would provide service 99.9 per cent of the time between any two points on earth." To this end, it intended to launch about 50 communications satellites.

September: The OS Arrives...?

The Atlas Computer became operational at Manchester University. Considered the fastest and most sophisticated computer of its time, it also pioneered concepts like virtual memory and compiler compilers. The Supervisor, a central program that managed the resources of Atlas, is considered a forerunner of today's operating system.

September: The Laser Diode

Robert Hall demonstrated the laser diode. This type of laser—the semiconductor laser—being easy to create and small in size, is the commonest of lasers. They are currently used in CD drives and laser printers.

Packet Switching: Enabling The Internet Today

Paul Baran designed Packet Switching. The Cold war was at its peak, and concern about the destructibility of the present com-

munication channels led the US government to seek alternatives. Baran's suggestion was to use a distributed network, one without any central monitoring and managing function. Packet switching involves breaking down the data to be transferred into small "packets" that contain additional information about its source and destination, in its "header." Each node on the distributed network is intelligent enough to read the header of the packet and either accept it or send it on its way. This way, the packets would ultimately be received by the destination even if part of the network was damaged. The original data is rebuilt at the destination. Packet Switching was only tested in1969 during the creation of the ARPANET, and was found to be the most effective and efficient way to transfer data on the network. The concept also forms the basis of today's communication on the Internet.

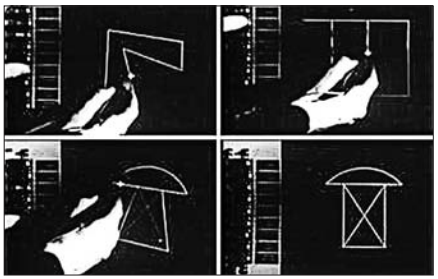
1963
Sketchpad, ASCII

January: The IEEE

The IEEE was founded by merging the AIEE (American Institute of Electrical Engineers) and the IRE (Institute of Radio Engineers). The need for the merger arose since it was felt that the two organisations were increasingly performing overlapping functions, resulting in duplication and competition.

January: Finally, The GUI

Ivan Sutherland created Sketchpad, a software that allows creation of designs merely by drawing them on the screen. Considered the first Graphical User Interface, Sketchpad involved the use of a light pen on the CRT



Sketchpad—you rarely see things like it even today

screen. Up until then, using a computer involved writing a program, so the ability to directly create shapes without any computing expertise was seen as a step towards bringing the user closer to the computer. Sketchpad had obvious applications in the field of computer aided design, and also introduced many concepts like object oriented programming, memory management for objects on the screen, and GUI-related aspects like zooming and interacting with objects. Sketchpad influenced the GUIs that came after it.

June: ASCII Standardises Things

The American Standard Code for Information Interchange (ASCII) was introduced. It was a collaborative effort between the US government and the computer industry. The aim was the standardisation of the different character codes that were being used. Till then, each computer maker had a proprietary code, and the transfer of data required the use of translation tables. The ASCII code consists of 128 unique combinations of ones and zeroes, with each sequence representing a letter of the alphabet, an Arabic numeral, an assortment of punctuation marks and symbols, or a function such as a carriage return. The chief designer of the code was Bob Bemer.

"Hypertext"

The term "Hypertext" is coined by Ted Nelson. He was considering a system to record and organise his thoughts and arrived at the concept of a mass of information linked to each other. He visualised a "Docuverse," where information is available and never deleted, and people can access any part of it by following links. Navigation, hence, would be non-linear, and subject to the choices of the user. The concept influenced people like Tim Berners-Lee, the creator of the World Wide Web—which is one implementation of Nelson's vision!

1964
Supercomputing, Moore's Law, BASIC

April: The BASIC Language

The programming language BASIC (Beginner's All-purpose Symbolic Instruction Code) was developed by John Kemeny and Thomas Kurtz at Dartmouth College. One of the main goals of this language was to allow non-technical students to use computers. Since using a computer then usually involved writing a program, it was essential that the language be simple. The compiler was given for free by the creators which contributed to its popularity. Many flavours were created by different users, who modified the language to suit their computing knowledge, though it would still cater to beginners.

April: IBM/360

IBM announced the first "family" of computers: the IBM/360. The series name 360 refers to the all-round compatibility of systems within the family, which meant that the data transfer did not require further processing. This was an important feature at a time when computers used proprietary standards and data transfers between them required a translation table. Unlike earlier computers that were created specifically for a particular organisation, the family concept introduced similar, basic computers that could be modified according to individual need. The /360 family included six computers, and was accompanied by over 40 peripherals that could be used with it. It was also the first computer to offer its users a guaranteed compatible upgrade option which would not need rewriting programs. To augment the /360 family, IBM also released the PL/I language compiler which could be used to create programs. The /360 family is also considered the first family of computers of the third generation, since they were entirely devoid of transistors: they used only ICs.

April: Moore's Law

Gordon Moore made the famous statement that would be later called Moore's law. His statement was derived from his observa-

tion, which was published in a magazine, regarding the exponential increase in the number of transistors that could be included in a single chip. Though he had originally observed that transistor count doubled every year, this was later modified to every two years. The statement was dubbed Moore's law in 1970.

October: The Dot Matrix Printer

Seiko Epson, the official time-keeper of the Tokyo Olympics, was asked to integrate a small printer with the timer so that human intervention could be reduced in the recording process. This lead to the invention of the dot matrix printer. The printer was not mass-produced for another four years.

Computers Get, Well, Faster!

The CDC 6600 supercomputer, designed by Seymour Cray, was launched by Control Data Corporation. Capable of performing up to 3 million instructions per second, it was three times faster than its closest competitor, the IBM Stretch. The 6600 retained the distinction of being the fastest computer in the world until surpassed by its successor, the CDC 7600, in 1968. Internally, the 6600 had 10 small computers, known as pre-processors, funnelling data to a large central processing unit.

Online Transaction Processing

American Airlines' SABRE system was launched. SABRE (Semi-Automated Business Research Environment), built by IBM, used teletype machines connected through dialup connections to mainframe computers to create an automatic reservation system. While the earlier manual method could take about 90 minutes to issue a ticket, through SABRE this duration was reduced to three seconds! This was a first implementation of an online transaction processing system. The network included 2,000 teletype terminals in various cities, connected to a pair of IBM 7090 computers.

Handwriting Recognition

The RAND tablet was developed by M R Davis and T D Ellis at Rand Corporation. Also called the Grafacon (for Graphic Converter), it is

considered the first user-friendly handwriting recognition input device. It used an array of touch sensitive sensors on the 10 x 10 foot pad to detect the position of the pen and transmit the x and y coordinates to the computer. The Rand tablet used Ellis' handwriting recognition software GRAIL (GRAphic Input Language) to convert the readings into meaningful content.

AI Advances: Expert Systems

Edward Feigenbaum, Joshua Lederberg, and Bruce Buchanan began developing the Dendral expert system. (An expert system is a computer program that can form intelligent opinion based on related information provided to it about a specific subject.) Lederberg was an organic chemist of repute who was considering the problems faced by his brethren when trying to discover the molecular structure of organic compounds. Feigenbaum, who was researching artificial intelligence, decided to create an artificial expert in a particular subject area to study the limits to which a computer could come to conclusions autonomously. The expert system, to be successful, should be first fed with information about the particular subject. Based on this established database, the expert system then applied rules to arrive at conclusions.

CAD Emerges

The DAC-1 (Design Augmented by Computers) computer-aided design program was released. Development began in 1959, with General Motors Research Laboratories exploring the use of computers in designing automobiles, in collaboration with IBM. DAC-1 involved the use of a light pencil that identified coordinates of its position on a conductive transparent sheet placed over the display console.

Something Like GPS

The US Navy's Navigational Satellite system (NAVSAT) becomes operational. Also called TRANSIT system, it used six satellites to identify the position of submarines to within a 200-metre accuracy. The TRANSIT is the predecessor of the present day GPS (Global Positioning System).

1965
Object-oriented Programming

January: Simula—Object-oriented Language

Simula, written by Kristen Nygaard and Ole-John Dahl, was released. It was based on the ALGOL 60 language, and was one of the first object-oriented languages. It was the first to use concepts like classes and objects, inheritance, and dynamic binding.

March: The Minicomputer Comes Into Its Own

Digital Equipment Corp. introduced the PDP-8, the first commercially-successful minicomputer. It was available at one-fifth the price of a small IBM/360 mainframe. The speed, small size, and reasonable cost made it affordable for small businesses and scientific laboratories, which led to the greater adoption of computers.

Commodore—Of Commodore 64 Fame

Commodore Business Machines was founded by Jack Tramiel; it started off by making calculators. Though it was once the largest single supplier of computers in the world, renowned for its Amiga line of PCs, it was out of business by 1994.

MULTICS

J C R Licklider, director of ARPA, who believed that the CTSS technology had useful applications in the agency, launched Project MAC with the objective to create a time-sharing system known as Multics. Choosing a GE 600 series machine as the basis for the development, MIT was joined by GE and AT&T Bell Laboratories to produce a general-purpose, shared-memory multiprocessing timesharing system.

1966
The First Modem

January: The Eliza program

Joseph Weizenbaum, working at MIT's Artificial Intelligence Lab, created a program called ELIZA. It was created to respond to users'

A Friendly Chat

Weizenbaum created Eliza as a part of his study titled : "ELIZA--A Computer Program For the Study of Natural Language Communication Between Man and Machine". The name is derived from the character named Eliza Doolittle, from the play "Pygmalion" by George Bernard Shaw. For the first creation, the psychiatrist ambience was selected because the creator felt that under those circumstances the amount of information that would be needed to be fed in to create the impression of intelligence would be small. Only 200 lines, Eliza was, nevertheless, quite intuitive since it could incite people to discuss private personal problems. Weizenbaum who was not prepared for the response his program received, was disappointed because of the negative reactions he got when it was revealed that Eliza was a program who couldn't truly understand a user.

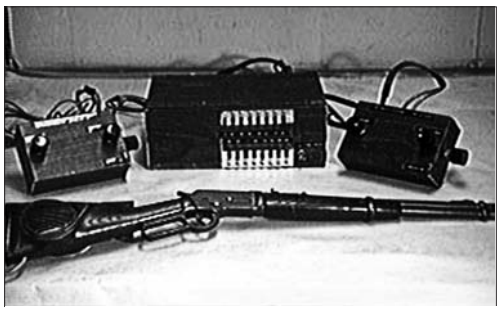
A session with Eliza went something like :
User : I am unhappy.
ELIZA : Do you think coming here will help you not to be unhappy
User : I need some help, that much seems certain.
ELIZA : What would it mean to you if you got some help
User : Perhaps i could learn to get along with my mother.
ELIZA : Tell me more about your family
User : My mother takes care of me.
ELIZA : Who else in your family takes care of you
User : My father.

The responses were created from a set of rules which were based on keywords occurring in the user's statements. In case a response tallied with more than one rule, a random selection was made. In case there were not matches, ambiguous messages like "That is very interesting. Why do you say that?" wre used. ELIZA inspired many clones, presently called "Chatbots", and characters in games. The original version of ELIZA can be sampled at **http://chayden.net/eliza/Eliza.html** (requires Java).

statements based on a set of rules by reusing the terms in the user's statements. It gave the impression that it was an intelligent human being. Though when it was first launched it was scripted to respond to users as a psychiatrist, ELIZA could be modified to respond in different milieu by changing the set of rules.

September: Ralph Baer's First Game

At Sanders Associates, Ralph Baer invented a video game in which two dots chase each other around a screen. The video game industry is believed to have had its origins in his work. While there were games that could be run on mainframes, Baer was interested in creating games that could be played at home with the TV as display. Initially though there was a lot of interest, the first commercially-available console only came out in 1972, and allowed the user to switch between games like ping-pong, volley ball, and shooting games.



An early game console with a light gun

Long-distance Data Transfer

The modem was first created in 1960 and was used to convert (digital) data from the computer into analogue sounds (and vice versa) that could be sent (and received) over ordinary telephone lines. But because these modems were very susceptible to noise in phone lines, long distance data transfers were not practical, and modems were restricted for data transfer across short distances, mostly within the building. John van Geen of the Stanford Research Institute changed all that. His modified modem reliably detected bits of data despite background noise, making long-distance data transfers feasible for the first time.

1967
The ARPANET

October: The beginning of the ARPANET

Work on the ARPANET begins. The US Military-sponsored ARPA (Advanced Research Projects Agency) realised the need to create a network of computers so as to protect its communication capabilities in case of any conflict (during the Cold War with the USSR). The ARPANET grew over time and the infrastructure and technologies developed for it fuel what is called the Internet today.

The Seed

Though ARPANET was a military-funded project, the active participation of the brightest minds from academia and business were sought. Since it was a first of its kind, the pioneers behind ARPANET had to create every aspect of the network and data transfer from scratch. The protocols were the critical first step since there were many different proprietary computer systems that would be connected to each other. The initial idea involved creating a separate computer tasked with managing the transfer of data between the host PC and the network. This computer was called the Interface Message Computer, and is the precursor to today's Router. The Network Control Protocol, a set of rules that allow the disparate computers to communicate with each other was the precursor to the present Transmission Control Protocol (TCP). The first node on ARPANET, which was established in 1969, was at UCLA (University of California, Los Angeles), which also had the facility to monitor network status. The second node, also set up in 1969, was at SRI (Stanford Research Institute). The first message was sent through the network in 1969 and it read: "lo". The first message was the result of an attempt to "login" to the computer at SRI from UCLA, but the system crashed midway. Two more nodes came up in 1969, at the University of California at Santa Barbara and the University of Utah.

The Beginnings Of ASIC

Micromosaic was created by Fairchild. It was a pioneering effort that is seen as a precursor to Application Specific Integrated Circuits (ASIC), which are widely used today. Micromosaic consisted of a number of unconnected transistors. Based on the expected function to be performed, a computer program would create a map of the necessary connections which would then be used to complete the circuit. Micromosaic is also considered the first real application of CAD (Computer Aided Design).

The First Small Solid-state Calculator

Jack Kilby, John Merryman, and James VanTassel developed the first solid-state hand-held calculator at Texas Instruments. It could handle numbers with a maximum of 12 digits and perform the four basic functions. To make the calculator portable, rechargeable batteries were used, which could power the device for four hours. It would not be commercially produced until 1971.

The Floppy Disk

A team headed by David Noble from IBM created the first floppy disk. Using 8-inch magnetically-coated disks, the initial use was to load booting instructions to start IBM's mainframe computers, which till then had to be done with tape disks. Data could be stored only on one side of the disk, the storage capacity was 80 KB, and it could only be read from and not written to. Since the open disks got dirty, a cover was later added.

Laser Printing

Gary Starkweather, a Xerox employee, considered the use of lasers for printing. Starkweather started off working on creating a faster facsimile machine using a laser beam. Since the printer and facsimile machine share common areas, the leap was made. While he started to develop the idea, it was initially met with pessimism at Xerox, who could not identify any market for such a product. Eventually, the idea came to fruition at Xerox's PARC facility four years later. Xerox later sold the rights of the laser printer to HP.

1968
The Coming Of Intel And The Software Industry

July: Intel Arrives

Robert Noyce and Gordon Moore, employees at Fairchild Semiconductor, which they had co-founded, started another venture on their own. Initially called Moore Noyce Electronics, they decided to change the name since it sounded similar to "more noise". They operated briefly under the name NM Electronics, till finally deciding on "Integrated Electronics", shortened to Intel.

October: Apollo 7—ICs On Board!

Apollo 7 was launched. The predecessor to Apollo 11 which landed on the moon a year later, the Apollo 7 was a manned, earth-orbiting spacecraft that was in space for 11 days. The navigation control was managed by the onboard Apollo Guidance Computer, built by Raytheon. It contained 4,000 Integrated Circuits. Being a major buyer of integrated circuits, it is acknowledged that the space program was instrumental in advances in integrated circuits. The Apollo Guidance Computer was also part of the lunar landing Apollo 11.

December: The software industry as no-one knew it

IBM was faced with a lawsuit accusing it of bundling software and system engineering services along with the hardware, which restricted opportunities for other vendors. The result was the bifurcation of the hardware and software services of IBM. Henceforth, IBM had to price and sell software discretely from the hardware. This step is considered to have lead to the creation of a distinct software industry.

December: Doug Engelbart's all-included system

Called the "Mother of all Demos", Douglas Engelbart demonstrated the NLS (Online system) in a 90-minute live demonstration at the Joint Computer Conference in San Francisco. The NLS system incorporates hypertext and distributed collaboration, keyboard, keypad, mouse, windows and video conferencing—far ahead of their time.

Why He Did It

Engelbart's aim was to make a computer user-friendly so that it could actually be used to improve life for human beings. The significance of the first public display of the pioneering features that constituted the NLS system is captured well in the phrase "Mother of all Demos". Engelbart had been developing on these features since 1963, when he was working for the Stanford Research Institute sponsored Augmentation Research Center.

The first computer mouse was a wooden box with two wheels below set perpendicular to each other (the mouse ball came later). It was patented under the title "X-Y Position Indicator for a Display System", and was named a "mouse" by Engelbart. The mouse was used to interact with the GUI called windows, which was the first time such a GUI was displayed. Since software patents were not being given, he could not patent his "windows".

The demo was also the first implementation of the Hypertext concept, by which documents that were linked were retrieved.

In the demo, Engelbart also held a videoconference with his associates at a different location. This was thanks to the network that had been set up by ARPA, which, too, funded his work.

The combined use of communication channels with hypertext and e-mail in the NLS makes it a precursor of groupware, a type of application that allows a group of people to collaborate on the same piece of data.

The demonstration, though spectacular, did not make any significant impact on the general public. Most of the features became publicly accessible long after 1968. For example, the mouse became popular when it was first bundled with the first Apple computer in 1980, and the hypertext-inspired World Wide Web became popular in the 1990s.

Pascal Gets Off The Ground

Development on Pascal was started by Niklaus Wirth, who wanted to create a language to teach programming concepts to students. Based on another computer language, ALGOL, which was also developed by Wirth, Pascal incorporated features of other languages of the time, like COBOL and FORTRAN. The development was completed in 1970. The advantages of the language ensured that it was accepted in non-academic circles as well.

1969
UNIX, And The First Dialup Service

April: UNIX

Bell Laboratories, originally a part of the team tasked with creating the Multics time-sharing system, a project funded by ARPA, did not agree with the emphasis on multi-user capabilities, so it began working on its own operating system. Programmers Kenneth Thompson and Dennis Ritchie developed the UNIX operating system as a consequence. UNIX, which laid emphasis on single-user features, was deliberately named so in contrast to Multics to emphasis this aspect. Nevertheless, UNIX did sport many of the timesharing and file management features offered by Multics.

May: And Then Came AMD

Jerry Sanders the Director of Marketing at Fairchild Semiconductor started a company along with seven other Fairchild employees. The company was Advanced Micro Devices. AMD would pose the strongest challenge to Intel in the microprocessor market.

October: The Beginnings Of The IC

Busicom, an electronic calculator manufacturer, approached Intel for the manufacture of 12 discrete ICs to be used in its products to perform different functions. Intel later (in 1971) designed and created a single chip containing 2,300 transistors...

November: The Robotic Arm

Victor Scheinman designed the Stanford Arm, the first successful electrically-powered, computer-controlled robot arm. It had six joints and was operated by a PDP-6 computer. It was used to develop assembly techniques for robots in an industrial environment.

CompuServe Starts Up

The CompuServe Information Service was launched. Based in Ohio, the first computer time-sharing service available to the public, allowed users to connect to the network through dialup lines. It is considered the first commercial online service.

The Coming Of The Serial Port

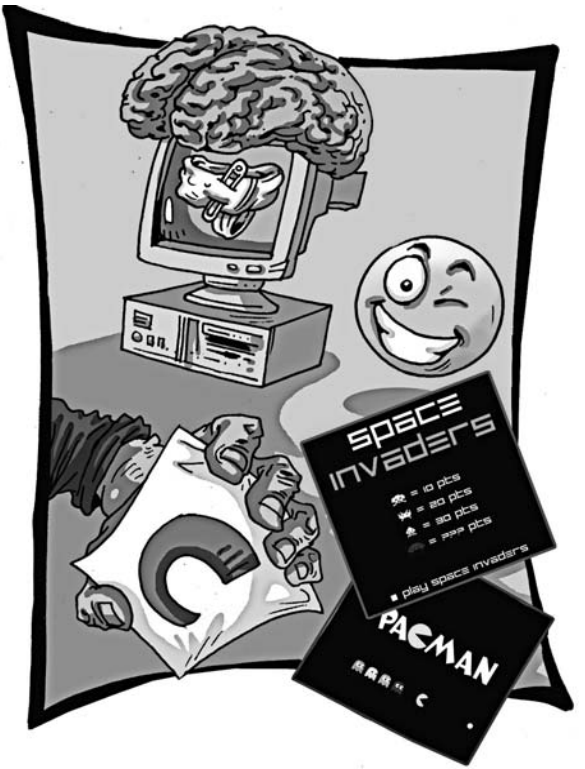
The EIA (Electronic Industries Association) standardised the RS-232 interface. This interface allowed computers and peripheral devices to transmit information serially. The RS-232 interface was also called the serial port.

Multiplayer Games

Rick Blomme wrote a two-player version of Spacewar! for the PLATO (Programmed Logic for Automatic Teaching Operations) system which supported multi user time sharing. It allowed two users on different terminals connected to the system to play, making it the first multiplayer game.

1969 saw Busicom asking Intel to manufacture what became the first microprocessor. 1971 saw it completed. Read on...

The Microprocessor Decade



The innovations, inventions, and developments continued—in both hardware and software. The hardware side saw the birth of the microprocessor, a variety of personal computers, commercial supercomputers, the hard disk, and more. Computers got smaller. The software side saw developments in programming languages—C, SQL, and many others. This decade also saw the first-generation video game consoles.

1970: Xerox PARC

February: SRAM

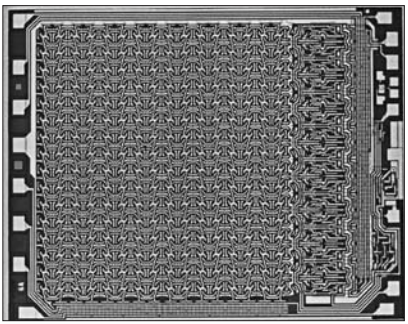
The first 256-bit Static RAM, called the 4100, was introduced by Fairchild Semiconductor in 1970, designed by H T Chua.

After selling silicon chips that carried memory, Intel publicly released the first Dynamic Random Access Memory (DRAM) chip, known as the 1103, in October. It was the first generally-available 1024 bits Dynamic RAM (DRAM) memory chip. The advantage of the 1103 chip was its speed; it had a lower access time, even though being "dynamic," it had to be refreshed several times a second. It was expensive, but a success nevertheless.

Eventually, semiconductor companies realised the benefits of saving time as well as cost and the performance advantage of semiconductor memories over the then-predominant magnetic ferrite core memories.

March: An intelligent robot

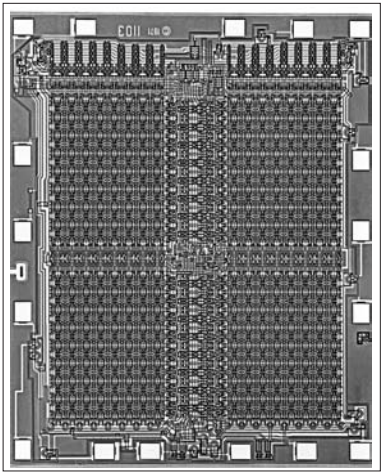
Shakey, the first mobile robot controlled by artificial intelligence, was created by SRI. Equipped with sensing devices, like TV camera and bump sensors, to monitor the environment; and driven by a problem-solving program called STRIPS, the robot found its way around the halls of SRI by applying information about its environment to a route. The environmental data collected by Shakey was transmitted to a DEC PDP-10 and PDP-15 which then radioed back commands to Shakey—which acted accordingly.



The first bipolar 256-bit Static RAM: the Fairchild 4100

July: PARC is founded

Xerox Corporation brought together a team of world-class physics and information sciences researchers to found a now-world-famous entity—the Palo Alto Research Center (PARC): a research centre where many groundbreaking technologies and ideas have sprouted—such as laser printing, the graphical user interface, Ethernet, object-oriented programming, distributed computing, and ubiquitous computing.



Dynamic RAM, though expensive, created a stir in the market

In addition, many innovations have been inspired by the research at PARC. For instance, Steve Jobs once visited the place, and was impressed by the graphical user interface and mouse used on the Alto Computer (a PARC innovation). He visited it later in 1979 (after he'd bought a stake in Xerox), and that was inspiration enough for the Apple Lisa released in 1983, and also the Macintosh, released in 1984.

Xerox, unfortunately, was unable to market the best of what PARC produced—apart from laser printing technology. The Center continues to make breakthrough innovations in the fields of computing and information science.

December: One more step for networking

ALOHAnet was developed by Norman Abrahamson at the University of Hawaii. Based on HAM radio, all computers in the various centres in the university were linked. The nature of data transmission was haphazard since the Ham radio network was created such that a piece of data, unless received by the original

intended node, would be retransmitted. Concepts that were developed at ALOHAnet, like the need to reduced data collision among data packets, were used for the same effect in the case of the Ethernet protocol.

1971
The Microprocessor Arrives

July: The beginnings of Project Gutenberg

Michael Hart, a University of Illinois student, gained infinite computing time on the University Mainframe computers. Specifically, on the Xerox Sigma V mainframe at the Materials Research Lab of the University, he gained computing time that had an estimated value of $100 million then (Rs 3,700 crore today). This meant he could use the Sigma V for an unlimited period for his research purposes. He wanted to gift back something of value to the community, so he started Project Gutenberg. He set a goal of making electronically available the 10,000 most-consulted books and copyright-free public domain works. The first text Michael Hart made electronically available was the United States Declaration of Independence.

October: The first e-mail program

Ray Tomlinson, then 30, found a way to send text over a network while working on a project called SNDMSG. We now call this e-mail. Tomlinson, along with a team working on the TENEX operating system, wrote the first basic e-mail programs SNDMSG and READMAIL.

Many believe that Tomlinson was the inventor of e-mail, but in point of fact, he invented the software that allowed messages

Where You @?

Ray Tomlinson, then employed with BBN (Bolt Beranek and Newman), which used Tenexa as the operating system, sent the first e-mail using the "@" symbol, creating a meaningful address: "user@host". His own e-mail address was Tomlinson@bbn-tenexa.

to be sent between computers. It is speculated that e-mail had been around since 1965: a program was developed by Fernando Corbató and colleagues to swap messages amongst the individual users of the CTSS at MIT, but communication between machines was possible only with those terminals on which the System was installed.

(Later, on the request of the director of ARPA, Steve Lukasik, an e-mail management program called RD was written by Larry Roberts in July of 1972 as an improvement upon READMAIL. RD enabled the listing of incoming messages, and supported replying, forwarding, and filing them in any order.)

November: The Big Landmark—Intel's 4004 Microprocessor

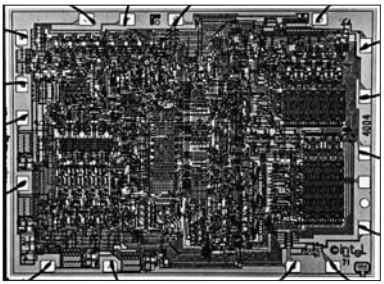
The CPU, which is often referred to as the brain of a computer, happens to be a microprocessor. Today, besides computers, thousands of products carry a microprocessor: consumer electronics, portable items, mobile phones, embedded systems, and more. The first microprocessors were designed as components for electronic calculators. The invention of the Integrated Circuit in the late 1950s had revolutionised the second generation of computers in the 1960s.

If you remember, a Japanese calculator manufacturer called Busicom had signed, in 1969, a contract with Intel to develop a dozen ICs for an electronic calculator—for their five calculating machines. A team of three engineers—Federico Faggin, Marcian E "Ted" Hoff, and Stanley Mazor—was put to the task. But instead of making a dozen chips, the team came with a chip design that included four chips: nine months of hard work resulted in the 4004, a 16-pin microprocessor that was one-eighth by one-sixteenth of an inch large. It had 2,300 metal-oxide transistors and was as powerful as the ENIAC (built in 1946).

The tiny four-chip design was packed with the 4004 (a central processing unit chip, the CPU); the 4001 (a read-only memory chip, the ROM); the 4002, a RAM chip; and a shift register chip for

input/output. Intel named this design the 4004 and also referred to it as the MCS-4 (Microcomputer Set 4).

The 4-bit Intel 4004 could execute 60,000 operations per second at a clock speed of 740 kHz, and was the first ever universal central processing unit. (Intel's first *single-chip* microprocessor, the 8085, was introduced in April 1976.)



The 4004 was meant for numerical calculations, but it could perform other computing tasks as well

Masatoshi Shima, then a Busicom engineer working with the Intel trio, had designed the logic for the 4004 chip and later joined Intel. The design of the 4004, which was initially sold to Busicom for $60,000 (Rs 2.2 crore today), was bought back by Intel. After that, Intel began developing the 4004 so it could be used for general computing purposes.

I Did It!

Even today, there is disagreement over who the credit for the development of the Intel 4004 should go to. Faggin left Intel in 1974. The major credit for development and creation of the microprocessor were attributed to Ted Hoff. The Reason that has often been cited is Faggin's step to start Zilog, which was started for the emerging microprocessor market and as a direct competitor to Intel.

2+2

Texas Instruments introduced the first portable handheld calculator in 1971, the research and development for which was initiated in 1965. Later, Hewlett-Packard introduced the first scientific handheld calculator in 1972.

Pascal is Ready

Development of the programming language Pascal, started by Niklaus Wirth in 1967, was complete. Pascal is named in honour of

Say It With A Zap

At the Xerox PARC, it was demonstrated that a modulated laser could be used to create an electronic image on a copier's drum. Thus came into existence the world's first laser printer, which could generate laser raster output scanner (ROS) xerography at 500 spots per inch.

philosopher and mathematician Blaise Pascal, who had invented the Pascaline (refer chapter 1).

1972: Games—And C

Spring Of 1972: The First Arcade Game

Nolan Bushnell played *Spacewar!* at the University of Utah in 1966; he saw commercial potential in the coin-operated version of the game. Bushnell, along with Ted Dabney, later created a *Spacewar!* clone, and eventually created the first arcade game, *Computer Space*.

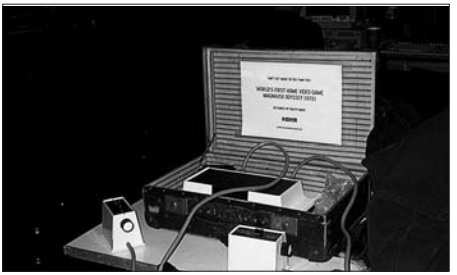
***Computer Space*: fancy, but too complex for the average!**

Computer Space was released by a "coin-op" game company, Nutting Associates, and unfortunately didn't do well commercially. The claimed reason for the failure is that *Computer Space* was too complex for an average drunk person, since the machines were placed outside liquor bars.

May To November: Consoles!

The Magnavox Odyssey was the world's first video game console, designed by Ralph Baer. A working prototype was completed in 1968; the game system was released in May of 1972. The system allowed one to play sports games like table tennis, volleyball, and

basketball, shooting games, and others.



The world's first home video game—the Magnavox Odyssey—which inspired the creation of *Pong*

After watching a demonstration of the Magnavox Odyssey, which also included Tennis, Bushnell wanted to produce an arcade version of tennis, which would be called *Pong*. Bushnell and Tabney wanted to incorporate a company under the name Syzygy, but found that a candle company in California already had that name.

The Atari Story

Following the Pong home console's popularity, many clones tried to enter the market, but weren't successful. The major ones were Coleco's Telstar and Magnavox's Odyssey 100 (an improved Odyssey).

Home video gaming picked up with the Atari 2600

Later, in early 1976, the MOS (Metal-Oxide Semiconductor) Technology 6502, an 8-bit microprocessor, was released. It offered high performance at low cost. Using this processor, Atari released the Atari VCS (Video Console System), later renamed the Atari 2600. It employed cartridges. That move helped the Atari 2600 become the most successful console in video game console history.

The enthusiasm for home video consoles slowly waned; later in 1976, Bushnell sold Atari Inc. to Warner Communications. Two years later, he left Atari. In 1977 began the second generation of video game consoles.

Gamers' God

Nolan Bushnell (born 1943), an electrical engineer and entrepreneur, was named one of Newsweek's "50 Men That Changed America," and is recognised as one of the founding fathers of the video game industry.

Bushnell mulled over several words and finalised "Atari" as the name of the company. Atari was named after a move in the Japanese chess-like game Go, was incorporated in June 1972.

(Talks to release *Pong* through Nutting Associates and other companies were leading nowhere. Industry experts didn't express interest in the game. Bushnell and Tabney therefore decided to launch *Pong* on their own and thus established Atari Inc.)

Eventually, Bushnell and Tabney completed and released *Pong* in November of 1972. It was a coin-operated arcade game system, and consisted of a B&W television, special game hardware, and a coin-operated mechanism. The game itself was based on ping-pong (table tennis), hence the name.

Pong was the world's first popular arcade video game. It was a big hit in the video arcade game market, and is recognised as the first first-generation video game of the 1972—1977 period. In addition, the era is regarded as the time when the age of interactive television and digital electronics arrived.

The computers build after 1972 are referred to as fourth-generation computers; modern-day computers are labelled "fifth generation." The size of computers shrank with the developments taking place on Integrated Circuits—computing systems

Play My Tunes

A Compact Disc Read-Only Memory (CD-ROM) was invented in the US at Philips by Klass Compaan and Pete Kramer in 1972. Later, Sony and Philips officially introduced the CD-ROM format together in 1982.

that occupied a large room were packed into a chip that could be held in a palm.

Developments for five years resulted in Very Large Scale Integration and Ultra Large Scale Integration of components, which ensured packing more than 10,000 components that constituted transistor-based circuits on one single small chip. The new chips offered increased power, reliability, and efficiency at a lower cost.

Ye Olde MSPaint

Xerox PARC pioneered SuperPaint, an early pixel-based frame buffer graphics program, which was developed by Richard Shoup at Xerox PARC.

C For Miles

C was developed for writing the code of the first UNIX version for a DEC PDP-7 computer which had 8 KB of memory.

Federico Faggin began working on an improved (8008) processor. On the other hand, Texas Instruments released the TMS1000 one-chip microcomputer, created by their engineers Gary W Boone and Michael J Cochran.

While the use of microprocessors for general purpose computing was being made, the need to develop better programming languages for developing programs to run on the computing systems consisting of microprocessors arose.

October: Packet Switching on the ARPANET

The first public demonstration of the ARPANET in Washington, D. C. was a major success. It demonstrated packet switching by linking 40 machines and a Terminal Interface Processor to the ARPANET. Robert Kahn had organised the demonstration, and then was hired by Larry Roberts, then Director of ARPA.

Along with Vinton Cerf, Kahn wrote the specifications for and developed the Internet Protocol Suite: Transmission Control Protocol / Internet Protocol (TCP/IP). These were the first two defined networking protocols.

The Development of C

A majority of the programming languages that exist today were invented in the '70s. In 1972, Dennis Ritchie developed an imperative, procedural, system implementation programming language known as C at The Bell Laboratories to be used with the UNIX operating system. Although C was meant to be used for system software, it is also widely used widely for other applications. C was the beginning of other languages like C++, D, and Objective-C, and also influenced languages like Java, C#, Perl, PHP, JavaScript, and the C Shell.

Big Talk

Alan Kay, Adele Goldberg, Scott Wallace, Dan Ingalls, Ted Kaehler, and a group of other researchers designed an object-oriented, dynamically-typed programming language called Smalltalk in 1972. Though less well-known, it influenced the evolution of computer technology. The graphical user interface elements created using Smalltalk were incorporated into the Mac OS and Windows.

The language was named C since it had features drawn from an earlier language B, developed in 1969 by Ken Thompson. B was a stripped-down version of the BCPL programming language developed in 1967.

C was the language for the UNIX platform, so the growth and popularity of UNIX led to the growth of C. The kernel of UNIX and most of the other components were eventually rewritten in C.

Dennis Ritchie and Brian Kernighan wrote the first edition of the book *The C programming language*. Several features included in C were mentioned in succeeding editions of the book. Later at The Bell Labs, Dr Bjarne Stroustrup worked on C and developed the enhanced "C with classes" in 1979. It was re-named C++ in 1983.

C++ integrated high-level language qualities as well as low-level languages, and it is used for many kinds of programming, including object-oriented. C++ remains a work in progress; a new version,

dubbed C++0x, is currently being developed.

1973: Ethernet

May: Metcalfe and His Ethernet

The widely-used networking protocol for local area networks—Ethernet—was created by Robert Metcalfe and others at Xerox PARC. It was originally known as Alto Aloha Network. It was standardised as IEEE 802.3. The term "Ethernet" was derived from the physical concept of the ether. This became a popular way of connecting computers to enable data sharing and to access devices such as printers.

Ethernet has different derivations; the original was designed as 10base5—10 stands for 10 MBps, Base is the baseband communication used, and 5 stands for 500 metres, the maximum distance of communication between the machines. Fast Ethernet or 100BASE-T gives transmission speeds of 100 MBps. Gigabit Ethernet is a newer version, which provides speeds of 10 to 100 Gigabits per second.

Spell It Out

The first display of alphanumeric information on an ordinary TV set was achieved through a TV typewriter designed by Don Lancaster in 1973. The two memory boards in the original model were capable of generating and storing 512 characters as 16 lines containing 32 characters. About 100 pages of text could be stored in a 90 minute tape if used for storage.

Hello!

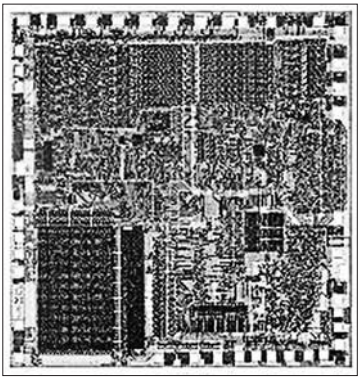
Dr Martin Cooper made the first ever cell phone call using a Motorola Dyna-Tac at Motorola in 1973. He is known as the father of the cell phone.

1974: Computers Get Ahead

April: The 8080

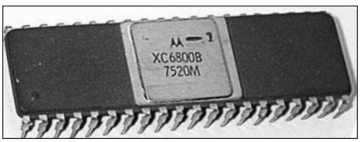
Intel released the 8080, an 8-bit microprocessor, the successor to the 8008. It ran at 2 MHz, and processed 6,40,000 instructions per second. It was designed by Federico Faggin and Masatoshi Shima

(an Intel employee and an ex-Busicom engineer) with contributions from Stan Mazor (an Intel employee). It had processing logic that made the porting of old applications easier. The chip was used in the Altair 8800, the personal computer then popular amongst computer hobbyists. The 8080 family is regarded the first truly usable microprocessor, and it also became a standard in the industry for microcomputers.



The 8080 was the first truly usable CPU design from the x86 family, created for any application

On the other hand, Motorola announced the MC6800 8-bit microprocessor which didn't use any support chips. It was considered better than the Intel 8080: it was more easy to use since it required a single power supply. It was sold more for industrial control requirement rather than general-purpose computing requirements.



Computing got a boost since the 6800 was better than Intel's processors for an industrial environment

August: Chips Get Cheaper

Forrest Mims and Ed Roberts along with Stan Cagle and Robert Zaller founded Micro Instrumentation and Telemetry Systems (MITS) in 1969, and sold radio transmitters and instruments for model rockets. They had plans for a microcomputer. While Intel sold their 8080 chips at above $300, Roberts got into a deal with Intel and for chips with surface defects for only $75.

A working sample of the microcomputer kit—called the Altair—was soon ready, and was formally launched in Popular Electronics' January 1975 edition.

Computing started becoming became personal yet affordable for hobbyists with the arrival of the Altair

Electronics hobbyists were turning towards digitising electronics, but were not happy with the inflexible kits available—and their low power.

The Altair plugged both shortcomings—it had enough power, and had a flexible system open to all sorts of experiments. The Altair 8800 was based on the 8080, and had 256 bytes of standard RAM. Hobbyists were eager to buy the Altair even at a price nearing $500 (Rs 70,000 today). Then the Altair 8800 was made available with different memory boards: 1 KB, 2KB, and so on up to 64 KB. Then the included 8-inch floppy drive triggered the interest of more hobbyists.

Roberts had received a letter from Bill Gates and Paul Allen from Boston to buy their BASIC programming language for the Altair machines. Gaining the interest of Roberts, the duo worked on a simulator for the 8080 on a PDP-10 minicomputer, and the first run displayed "Altair Basic" using paper tape! MITS was sold out to Pertec in 1977, and Pertec continued producing the Altair through 1978.


Computing became personal when the first personal computer—the Alto (not for commercial purposes)—was exhibited

September: The Alto

At Xerox PARC, a prototype of the world's first What-You-See-Is-What-You-Get personal computer called the Alto was demonstrated. The Alto had a GUI, a bitmapped display, and a commercial mouse as an input device. It was a research tool, not a commercial product; it offered features like menus and icons, linking to a local area network, and the storing of files. It was a small minicomputer and was termed a personal com-

puter because a single person could sit beside it and work!

IBM's Chamberlin And Boyce develop SQL

One of IBM's great gifts to programming was Structured Query Language (SQL). The first version of SQL, also called SEQUEL—Structured English Query Language—was developed by Donald Chamberlin and Raymond Boyce. Query languages are used to make specific information requests from databases. (A database is a collection of information organised in a structured manner such that a computer program can select desired pieces of data from it.) The name was changed from SEQUEL to SQL because a UK-based aircraft company had SEQUEL as a trademark.

Total Control

Dr Gary A Kildall, while employed with Intel, created CP/M (Control Program for Microprocessors) as an operating system for new microprocessors. Later, in 1977, CP/M became a popular operating system for microcomputers.

SQL was designed for manipulation and retrieval of data stored in the relational database System R, an original IBM product. SQL was standardised by the American National Standards Institute (ANSI). Variants of SQL have been created by SQL-Database Management System vendors; however, there were limitations to these like incompatibility with different vendor products, complex and vague language grammar, and lack of portability amongst cross-platform applications. Later in 1979, after Oracle was founded, it released the first commercial version of SQL.

1975: A Microsoft Milestone

April: Programmers Gates And Allen

Using BASIC, the programming language developed by John Kemeny and Thomas Krutz in 1963, Bill Gates and Paul Allen wrote a computer language for the Altair 8800. Gates and Allen then licensed BASIC to MITS for the Altair. Later, Gates dropped out

from Harvard and formed Microsoft with Paul Allen at Albuquerque, New Mexico in November. Microsoft was spelt Micro-Soft back then. In 1979, the company moved to Bellevue, Washington, and in 1980, Steve Ballmer joined and later succeeded Bill Gates as CEO.

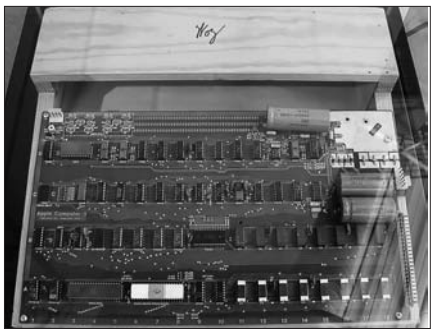
July: Telenet

DARPA began to feel that ARPANET was draining its resources; they asked AT&T if they were interested in buying it. AT&T didn't make the move; BBN (Bolt Beranek and Newman) opened a subsidiary named Telenet and bought ARPANET. Larry Roberts, ex-director of ARPA's Information Processing Techniques Office, along with Barry Wessler, were the founders of Telenet—the world's first private packet data communications carrier. A dialup service named PC Pursuit was offered by Telenet in the late 1980s; users could dial into the Telenet network of their city and then dial out to the modems of other cities for accessing Bulletin Board Systems (BBS) and other services. A BBS runs an application dedicated to allowing users to dial into the system using telephone or a terminal program for communication of messages or exchange of files. Telenet was acquired by Sprint after General Telephone and Electronics (GTE) had bought it in 1979.

1976: The Founding Of Apple

April: Apple!

Steve Jobs, Steve Wozniak, and Ronald Wayne founded Apple Computer on 1st April, 1976. Jobs was to handle the marketing, Wozniak to manage engineering, and Ronald Wayne, an ex-Atari employee, enjoyed a 10 per cent



Enthusiast Wozniak's single-board computer, the Apple I, left the computer industry in awe

stake. Later when Apple was formally incorporated, Wayne's share was divided among Jobs and Wozniak. For a detailed history of the evolution of Apple, refer to our *Fast Track to Apple*, July 2007.

Wozniak designed a single-board computer and named it the Apple I in 1976. He came up with an advanced logic board based on the MOS Technology 6502 microprocessor, 8 KB of onboard RAM and built-in Video terminals. After struggling to buy the parts for making the Apple I boards, Apple earned a 100% profit on its first sale. By the end of the first year, Apple had a turnover of $100,000 (Rs 1.4 crore today).

Later, in April 1977, Apple came out with the Apple II, the first personal computer with colour graphics, crammed with 62 chips and ICs. This machine was launched at the West Coast Computer Faire, the Microcomputer Trade Show at San Francisco, and the response from the crowd was fabulous. The Apple II was a successful machine on which Apple cashed enough to establish itself as a primary player in the computer business.

As the company began to expand, more challenges and expectations were to be met. By 1980, Apple had become a large multinational corporation and the same year launched the Apple III. But—due to mismanagement—sales of the Apple III dipped.

But eventually, when VisiCalc, the first ever computer spreadsheet, was developed, sales doubled. (After the 1980s, the Lisa and Macintosh hit the market; they featured a GUI and mouse.)

July: Intel Gets Competition

After Federico Faggin left Intel, he started Zilog with Ralph Ungermann, and it became a direct competitor to Intel in 1976. The Zilog Z80 was an 8-bit microprocessor design and was sold in July 1976. It was object-code compatible with the Intel 8080 CPU, which means machine language written could be understood by that CPU. It also offered many improvements over the 8080, and therefore became the most popular of the 8-bit CPUs.

The major reason for its success was the built-in DRAM refresh address mechanism that allowed systems to be built with fewer support chips. The Z80 was widely used in Desktop computers and embedded systems like in industrial / professional uses, musical instruments, sample synthesisers, and other consumer electronics.

Prints In A Flash

The first laser-electrophotographic printer, the IBM 3800, was introduced by IBM in 1975. It had a speed of 20,000 lines per minute; these were reflecting from an 18-sided mirror spinning at 12,000 rpm while the laser beam paths changed a million times per second.

December: The 5.25-inch Floppy

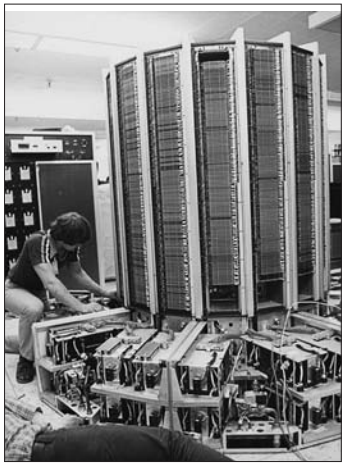
After the invention of the 8-inch floppy disk at IBM by a team lead by David Noble in 1969, the size of the disk was found to be too large for word processing machines. In 1976, Jim Adkisson of Shugart Associates developed a 5.25-inch minifloppy with a capacity of 98.5KB. Later, the storage was increased to 110 KB. These 5.25-inch drives were comparatively less expensive than IBM's 8-inch drives. Ten more manufacturers started producing 5.25-inch floppies. Later, in 1978, the 5.25-inch floppy drive became an industry standard.

The First Cray

Seymour Cray, known as the father of supercomputing, along with his research team, designed the Cray-1, the first commercially-successful supercomputer, for Cray Research in 1976. At the Los Alamos National Laboratory, the first Cray-1 system was installed for $8.8 million (Rs 123 crore today!) It had 8 MB of main memory and could perform operations at a speed of 160 million floating point operations per second.

For the best speed possible, it was designed in a "C" shape with no wire in the system longer than four feet. The entire system was Freon-cooled; there were 20,000 ICs. The Cray X-MP succeeded the Cray-1 in 1982. The National Center for Atmospheric Research paid

$8.86 million for one, becoming Cray Research's first official customer. This Cray model is also referred to as the first commercially successful vector processor, also known as array processor; it could simultaneously run multiple mathematical operations on multiple data elements.


Supercomputing became commercial with the Cray-1

Diffie-Hellman

A cryptographic protocol allows establishing a shared secret key over an unprotected channel amongst two parties that don't have any information about each other. It is commonly known as the Diffie-Hellman key exchange. Since no authentication is provided to either of the parties, it was insecure as any person could break in—so a password-authenticated key agreement form of Diffie-Hellman was also being used. A year later, in 1977, RSA algorithm followed the same method, another implementation of public-key cryptography using asymmetric algorithms.

1977: Modems And Oracle And Unix

May—August: BSD

An operating system considered as a branch of UNIX was developed at University of California, Berkeley. It was distributed with the name of "Berkeley Software Distribution" (BSD), and pioneered many of the advances of modern computing. Researchers at universities used the source code included in UNIX from The Bell Labs to modify and extend UNIX. Since many universities were interested in software, Bill Joy, a graduate student at Berkeley, assembled and distributed tapes of first Berkeley Software Distribution. Joy went on to become Sun's CEO in the 1990s.

Colour Me Good

The Apple II's colour graphics was the major reason for its instant success when it was released in 1977. It carried a printed circuit board (PCB), keyboard, game paddles, A/C power cord, and cassette tape, with the computer game *Breakout*.

Berkeley's UNIX was the first that included a library that supported the Internet Protocol. It was being used as the test-bed technology in various universities, free products, commercial products, and even in embedded systems. Under BSD licensing, companies were allowed to distributed proprietary software products without releasing the source code. It could be run Using a binary compatibility layer and native software of different OSes on the same architecture, and also, it was much simpler and faster.

The first BSD was like an add-on to UNIX' Sixth Edition, which had major new offerings such as a Pascal compiler and Joy's ex line editor.

A VAX computer got installed at Berkeley, but the UNIX/32V was unable to take advantage of the VAX's virtual memory. Berkeley students wrote the kernel of the 32V for enabling the use of virtual memory, and using the utilities from 32V, the third BSD was released towards the end of 1979. The third BSD is also known as VMUNIX (Virtual Memory Unix).

The credit of 3BSD's success goes to DARPA's funding of Berkeley's Computer Systems Research Group. This group would later develop a standard UNIX platform in the VLSI project for the DARPA research in the future. Post that, a number of BSD versions were released; the last was 4.4BSD. Many distributions have been developed and are available to use Based on 4.4BSD.

June: The Founding Of Oracle

Oracle was founded in California by Lawrence Joseph Ellison along with Robert Miner and Edward Oates. The company was initially formed by the name of Relational Software Inc. The first Relational

A New Era

The period between 1977 and 1983 is regarded as the second generation of video game consoles. The games on cartridges started being sold during the mid-1970s, in which game code was written on the microchips using discrete logic. These ROM microchips were packed in a plastic cartridge casing which would fit the console slot size. Out of many, three video game consoles dominated the second generation video game consoles—the Atari 2600 (1977), Intellivision (1980), and the Colecovision (1982).

The Atari Video Computer System was released as a cartridge-based console, and it was later renamed the Atari 2600. Intellivision from Mattel is part of the 8-bit era, having a unique processor that allowed a variety of instructions sets for a potential gain in speed. In addition, its graphics were considered superior to that of the Atari 2600. The Colecovision, introduced in 1982, was a powerful console whose sales took off initially but couldn't last long in the face of the competition.

Database Management System was based on the IBM System/R model, and in 1979, the first database management system (SQL RDBMS) was developed using IBM's SQL programming language.

The name "Oracle" came from the database engine which was being developed for a consulting project (code-named Oracle) with the US CIA. Ellison and Miner worked on the project where the CIA wanted them to use the new SQL language. Oracle is regarded the world's largest RDBMS vendor, which also develops tools for database development, enterprise resource planning (ERP) software, Customer relationship development software (CRM), and supply chain management software (SCM).

Enter the PC Modem: Hayes Again

The PC modem was invented by Dennis Hayes and Dale Heatherington. It was a communication-enabling device used to convert one form of signal to another for smooth transmission, that is, converting signals from digital to analogue and then from analogue to digital. Both Hayes and Heatherington market-

ed and sold the high-quality IBM PC modem in April of 1977. They found D C Hayes Associates, today known as Hayes Corp, in 1978.

1978: More Games

April :)

Kevin McKenzie sent an email to the MsgGroup with a suggestion to add symbols that could convey emotions along with the dry text medium of e-mail. He was the first to use "-)", which meant "tongue in cheek." Scott Fahlman suggested the use of the emoticons :-) and :-(for the CMU bulletin board system between 1981 and 1982.

Faithful PET

The Commodore PET (Personal Electronic Transactor) was the first of the several personal computers produced by Commodore in 1977. It was known as the first "full-featured" personal computer: the box contained a keyboard, a blue/white computer, OS on ROM which loaded on boot, graphics support, 4 KB of memory, a cassette tape for data storage, a power supply, additional CPU or RAM support, and a 1 MHz 6502 processor. The keyboard was also known as the 'chiclet board' since it had calculator-type keys.

Scott E. Fahlman's message:

19-Sep-82 11:44 Scott E Fahlman :-)
From: Scott E Fahlman <Fahlman at Cmu-20c>

I propose that the following character sequence for joke markers:

:-)

Read it sideways. Actually, it is probably more economical to mark things that are NOT jokes, given current trends. For this, use

:-(

May: The 8086

The Intel 8086 processor, the first processor to join the x86 architecture families of processors, was released. The complete 16-bit architecture of 8086 had 16-internal registers, a 16-bit data bus, and a 20-bit address bus. Intel later released the Intel 8088, an 8-bit version, which was also used in the original IBM PC.

The 8086 was known as 16-bit processor as all its internal registers, internal data buses, and external data buses were 16 bits wide. (Registers are the processor's local storage area used to hold the data while it is being worked on by the processor. The internal data bus is what carries data internally within the CPU circuit, and it communicates among the internal memory caches of the CPU.)

Its clock frequency was originally limited to 5 MHz, and later versions of the CPU were manufactured using HMOS (High performance n-channel Metal-Oxide Semiconductor) technology specified for 10 MHz. The 8086 instruction set included a power set of a few instructions.

June: *Space Invaders*—And More

The popular arcade game *Space Invaders*, designed by Tomohiro Nishikado who worked as an engineer in Taito Corp., was released. It used an Intel 8080 processor that ran at 2 MHz. It is said that the look of the aliens were devised based on H G Wells' science-fiction story *The War of the Worlds*.

The original version of the game had monochrome video images; later, Taito added coloured bands on the reflective screen. *Space Invaders* became popular due to its unique gameplay—unlike other clock-timed video games, it was life-based.

The Beginning...

The first commercial computer built on an 8086 was the Mycron 2000. Also, IBM's Displaywriter word processing system, the Wang Professional Computer, AT&T 6300 PC, and the first Compaq Deskpro were based on the 8086 chip.

The home console version of *Space Invaders* on the Atari was a huge success, and after bundling this game, the popularity of Atari increased. Like in the case of consoles, video game manufacturers came up with clones of *Space Invaders*, but none were as successful as the original. Several sequels of *Space Invaders* have been released:

- Space Invaders Part II (1979)
- Return of the Invaders (1985)
- Majestic Twelve: The Space Invaders Part IV (1990)
- Space Invaders DX (1994)
- Space Invaders '95: The Attack Of The Lunar Loonies (1995)

Players would spend hours trying to beat the high scores by fellow players. It became addictive amongst school-going kids as well as teenagers. In the late 2000s, sequels of *Space Invaders* were re-released for different gaming platforms—PC, PlayStation 2, Xbox, Pocket PC, and Windows smartphone. It is still regarded as one of the most addictive second-generation video games.

September: WordStar

MicroPro International was founded by Seymour Rubinstein. Then John Bobbins Barnaby, a systems programmer at IMS Associates, and Jim Fox joined MicroPro; they together completed the first version of WordStar, a word processor software for the CP/M OS-based microcomputers. It was offered for sale at a charge of $495 for the software—which was pretty high—and $40 for the manual, in 1979. Later, it was developed for MS DOS (in 1982) and it enjoyed a major market share for word processing software in the early 1980s.

December: The USENET

The USENET is a worldwide distributed discussion system that evolved from the UUCP (Unix to Unix CoPy) architecture. Tom Truscott and Jim Ellis were the brains behind the USENET. It consists of a large number of newsgroup sets with names classified subject-wise hierarchically.

It is the oldest computer network communications system that still exists. Articles or messages posted are organised into topical

categories known as newsgroups. The "Big-eight" set of worldwide newsgroups that exist currently are:

- Comp.*: Computer-related
- News.*: Discussions and announcements about news
- Sci.*: Science-related discussions
- Soc.*: Social discussions
- Talk.*: Talk about controversial topics
- Rec.*: Recreation and Entertainment
- Humanities.*: Fine Arts, Literature, and Philosophy
- Misc.*: Miscellaneous topics

The USENET resembles the Bulletin Board System (BBS), and is termed the predecessor to a large number of Web site forums that exist even today.

Now, with so many Web-based forums, blogs, mailing lists, and so on, the use of the USENET is diminishing—in fact, it has become quite niche.

VisiCalc Meant Business

The Apple II personal computer turned into a business machine after VisiCalc was developed by Harvard MBA candidate Daniel Bricklin and programmer Robert Frankston in 1979. It was the first spreadsheet-like program to be developed, as we've mentioned. The program was developed by Software Arts and distributed by Personal Software, later named VisiCorp.

Bricklin got the idea of VisiCalc while he was at Harvard and watched the university professor erasing and re-writing the faulty entries of a financial model on the blackboard. He then realised that the same process could be replicated using an e-spreadsheet.

1979: Wintel—The Idea

April—June: Microsoft Writes MS-Dos

Microsoft was commissioned to write the operating system for the upcoming model of the IBM PC, since Microsoft was known mainly for their programming languages. Microsoft developed MS-DOS, which was selected by IBM as PC-DOS for their IBM PC.

Prior to that, Tim Paterson wrote 86-DOS, which was 4,000 lines of assembly code, for the computer manufacturer Seattle Computer Products, in 1980. Since it was designed to run on an Intel 8086 processor, it was called 86-DOS. 86-DOS was also known as Quick and Dirty Operating System (QDOS). (Microsoft re-branded 86-DOS as MS-DOS in July 1981.)

More Space!

Seagate Technology was founded by Alan Shugart and Finnis Conner in 1979. Their first product ST-506 was the first 5.25 inch hard disk.

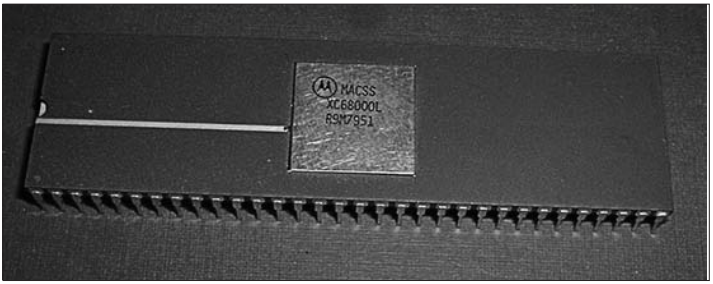
A statement issued by Microsoft about the development of MS-DOS went thus: "DOS addresses only 1MB of RAM because we cannot imagine any applications needing more."

MS-DOS had a command-line interface along with batch scripting facility through its command interpreter and COMMAND.COM. But it lacked multitasking capabilities.

September: The 68000

Motorola Semiconductor Products designed and sold the Motorola 68000 processor, the 68k family processor. Regarded as a successful 32-bit microprocessor, it resulted from the Motorola Advanced Computer System on Silicon project, which had begun in 1976.

Also in 1979, Intel released its 8088 microprocessor with 16-bit registers and 8-bit external data bus, and could address up to 1 MB memory. It was based on the Intel 8086 and also updated the maximum addressable memory limit by 64 KB, more than theoretical-



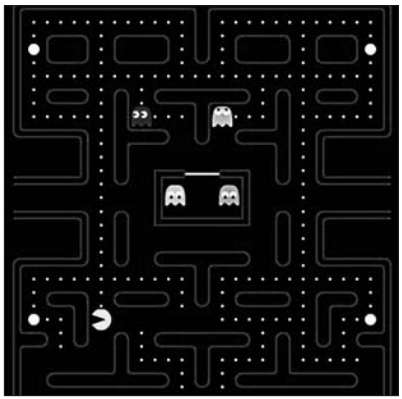
The faster processing speed of the Motorola 68000 left all the other microprocessors behind

ly possible with the 8086. (Maximum Addressable Memory determines how large programs can be).

However, the Motorola 68000 ran at a processing speed that left all then-contemporaries behind. It was looked upon as a high-performance processor, and found its place in workstations for graphics-intensive programs. The 68000 was also used in the Apple II.

October: Pac-man

The phenomenally popular game *Pac-man* was released in Japan. It was developed by Namco (now Bandai Namco), and its distribution licensee in US was with Midway. Toru Iwatani, a Namco employee, developed the game. This game was immensely popular and was also considered an icon of 1980s popular culture.



An addictive game that became popular due to its different gameplay

When *Pac-man* was released in North America, people were playing shooter games like *Space Invaders* and *Asteroids* and *Pong* clones. But Pac-man was different—it was attractive. It went on to become one of the most famous arcade games of all time.

Novell—And NetWare

Novell Data Systems came into existence as a computer manufacturer and operating system developer. The entire capital of the company was spent in designing hardware, which left no funds for marketing. NetWare was their first proprietary hardware server, based on the Motorola 68000.

In 1982, when the company was running shallow, Raymond J Noorda, who was then a 58-year-old electronics engineer, was quite impressed with their products. Noorda had been with General Electric for about 20 years, and already had turned around other fledging computer start-ups.

After Noorda became the ninth president, he invested about $125,000 (Rs 66 lakh today) from his own pocket, borrowed $1.3 million (Rs 0.7 crore today) from investors, and received a 33 per cent stake in the company. In the early 1980s, Novell rolled out NetWare, the first LAN software based on file server technology. (A file server is a computer that allows storing of files, programs, and resources on its hard drive or other storage medium. It enables the functionality to access files and resources stored on a particular server over the network. So any files and / or resources could be accessed from any computer on the same network.)

The GUI, MAC And Windows

The decade of the dawning, this one—the dawning of many things; in fact, many things that directly constitute your computing experience today. The GUI, the PC, the Mac—what more could a historian ask of a decade?

1980
Seagate And Fortran

February: The ZX80

A British company Sinclair released ZX80 computer for £100 (the equivalent of Rs 16,000 now) in 1980. It is also termed as the first "affordable" home computer taking the price into consideration. Jim Westwood, chief engineer at Sinclair Research, had designed the ZX80 using a Z80 CPU running at a clock speed of 3.25 MHz. The system also had 1 KB SRAM and 4 KB ROM, on which the Sinclair BASIC programming language, editor and operating system were loaded.

Available in two versions—self-assembly and ready built, Sinclair's distinctive look suited hobbyists and potential home users. The attractive aspect of ZX80 was the membrane based keyboard and the plastic casing, both of them were claimed to be waterproof. The multifunctional keys could be used to enter BASIC-commands at a touch. However, it still had drawbacks: no sound support, no colour and slow program execution. Later an improved version ZX81 was released which was bit cheaper than ZX80.

June: Seagate—Ever A Pioneer

Seagate Technology was formed by Alan Shugart, from Shugart Associates, with Finis Conner, a co-worker at IBM. The company created the first hard disk drive for microcomputers in 1980; it could hold 5 MB of data.

(Note that the first *ever* hard disk, the 305 RAMAC, was invented by IBM in 1956. The storage capacity was five MB on 50 disks, each of which were 24 inches in diameter.)

The hard disk contained a thin metallic platter coated with a magnetic material. After this was launched, Seagate got orders from big customers like Apple Computers and IBM. Through the 1980s, their ST-225 20 MB disk and ST-251 40 MB disk were their best-selling products.

Also in the same month, the first optical data storage disc was developed by Philips; it had 60 times the storage capacity of a 5.25-inch floppy disk. Two years later, in 1982, Philips came out with an erasable optical disc.

Games For Almost All Computers

In 1980, two brothers Doug and Gary Carlston formed a company, Brøderbund to market the games created by Doug. The first hit was scored when Doug wrote Galactic Empire for the TRS-80, a Zilog Z80-based home system. Then the company also started exploring opportunities in the educational and entertainment software markets. Brøderbund soon became one of the most popular publishers - they had released games for almost all major gaming systems. Most games published by Brøderbund at the end of the 1980s grossly focussed on education and productivity areas.

FORTRAN Is Completed

IBM's oldest developed "high-level" language FORTRAN was designed by IBM's group during 1950s (refer chapter 2). American National Standards Institute published a new standard—ANSI X3.9-1978 and the standard definition of FORTRAN was updated. The final draft of FORTRAN 77 was completed in 1977, International Standards Organisation adopted it as International Standard (IS 1539:1980) in 1980. Still, FORTRAN 77 had many missing features—such as a difficulty representing data structures succinctly—which lead to further development of the language known as 'FORTRAN 8x'. FORTRAN was a heavily used programming language for the development of non-commercial programs in the mid-1970s.

A Commercial 16-bit Microcomputer

Mycron released the first commercial 16-bit microcomputer, the Mycron 2000 than ran on the CP/M 86 OS. This computer is used by Digital Research as the development platform for the CP/M-86 operating system. Digital Research was brain child of Dr. Gary Kildall, the creator of CP/M operating system. He found Digital Research for the development of CP/M Operating System and related products.

1981
Portable, Pretty, Popular, Personal!

April: The Laptop

The world's first "laptop"

The first commercially-successful portable computer, the Osborne 1, was launched by Adam Osborne, founder of the Osborne Computer Corporation (OCC). With that launch, the idea of bundling commercial software applications with computers became the norm. This model came with the WordStar word processor, compilers for the CBASIC and MBASIC programming languages, and the SuperCalc spreadsheet application. Though the Osborne 1 included software worth $2,000 (about Rs 1,08,000 now), it was shipped at a price of $1,795 (about a lakh today). It was this aggressive pricing that made the Osborne 1 very popular, and it set the rules for PC marketing for years to come.

The Osborne 1 was designed to be rugged and easy to carry around. It was just as big as a mini-suitcase. This is also considered the first luggable PC, the ancestor of today's laptop. At its peak, the OCC sold ten thousand units in a month. Its only shortcoming was its tiny, 5-inch screen. This was necessitated by the two floppy drives on either side of the screen.

The keyboard folded into the casing, just like the top of a briefcase. It had an optional battery pack. Due to the small screen, you could only view 52 characters of text per line. You could, however, use the navigation keys to scroll left and right when the screen displayed 128 characters. The laptop ran the CP/M operating system.

Following its success, the Osborne 1 was quickly copied by other computer manufacturers, and was later edged out by the Kaypro II, which came with a larger screen and better third-party applications.

Though updated models were introduced, OCC could not replicate the early success it had with the Osborne 1, and eventually filed for bankruptcy.

April: The GUI

While IBM was busy making the IBM PC with its PC-DOS OS, Xerox Corporation was experimenting with a radically new concept that would allow users to interact with files and desktop objects in a graphical user interface design, in April of 1981.

The GUI of The Star workstation was well ahead of its time

The Xerox 8010 "Star" Information System was the first OS to use the concept of the Desktop with documents and folders. Different types of files had different icons associated with them. The concept of "Object Integration" was designed into the OS from the start; users could now click on a file on the Desktop and it would open up in its associated program—and, for example, a graph made in a charting application could be inserted into any file. This kind of functionality was a quantum leap from the OSes of the day.

The "Star" Information System was targeted at the office workspace; it successfully implemented the "what you see is what you get" (WYSIWYG) concept, which was considered most important for the inbuilt applications like the text editor, spreadsheet program, and graphics program.

Though the 8010 sold only 25,000 units, it brought to the fore many innovative features that have been improved upon in the computers of today. WYSIWYG editing, Ethernet and networking services, commands like Print and File, and its window-based GUI set benchmarks for the rest of the computer industry.

It does seem that the 8010 was ahead of its time. It will also be remembered for inspiring Apple's Lisa and Macintosh computers and Microsoft's Windows, among many others.

May: Colour Comes Home


An ad for the VIC-20

The VIC-20 was the first ever colour-display home computer. It didn't include the display, of course; it could be hooked up to a monitor or TV or any kind of display unit. Launched in May by Commodore Business Machines, it went on to sell a million units. The reasons behind its success were its 8-bit memory and its colour display, and the fact that it cost $299.95 then (Rs 16,000 today). Its main competition at the time was with the BBC Micro and Spectrum series of computers, which were also targeted at home users—with attractive pricing and good colour displays.

The VIC-20 was earlier called "Vixen"; however, this name was inappropriate in Germany, its second-largest market, because it sounded like *wichsen*, slang for "masturbate". Therefore it was decided that the computer would be named "VIC", after the on-board Video Interface Chip.

Due to its small memory and low-resolution display compared to other computers of its time—which were running on 4 MHz processors and 16 KB of memory—the VIC-20 was mainly used for educational software and games. These were available on car-

Kermit (No, Not The Frog...)

Columbia University, in 1981, developed the Kermit protocol to transfer files between microcomputers, their servers, and floppy disks on their university network—just like the FTP protocol. It was important at the time because it was compatible with different types of computer hardware and software available. The protocol was ported to work on Windows, Linux, UNIX, Apple, and OS2 platforms. The Kermit Project is still alive, and co-ordinated by the University. It is used by the International Space Station to run a myriad hardware components encompassing many generations.

tridges and tapes. As its popularity increased, more and more software titles like home finance programs, spreadsheets, and communication terminal programs became available on cartridges.

Linus Torvalds, who later went on to write the Linux kernel, used the VIC-20 as his first computer.

June: Hayes' modem

Developed by Dennis C Hayes, co-founder of Hayes Microcomputer Products, the Hayes Smartmodem was the first commercially-successful modem. Its predecessor, the CAT, by Novation, was an acoustically-coupled modem. The Smartmodem however, used an external micro coupler to transfer data digitally from the phone lines to the computer, making the connection more stable.

The Smartmodem did have its problems, however. For one, computer manufacturers then had very different circuit board designs from each other, so it was difficult to fit the modem onto them all. It would also require individual driver software to run on different circuit board designs, often resulting in compatibility issues when incorrect driver software was used. Hayes decided to use the RS232C serial port, which was normally available on all circuit boards, to run his modem.

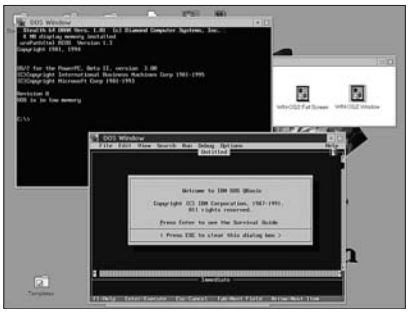
After a successful few years, the Smartmodem series and other modems died out due to increased competition from other modem manufacturers like USR and Telebit. Another reason for its tapering away was that Hayes was betting on ISDN to take off in a big way and had a line of products ready.

July: Microsoft Acquires DOS

Earlier known as QDOS (Quick and Dirty Operating System), MS-DOS was launched in July 1981. It lasted until Microsoft stopped development in 2000. By then, it had had eight version updates.

Originally written by Tim Paterson for Seattle Computer Products, it was bought over by Microsoft the same year. MS-DOS closely resembled CP/M-80, an OS of the time known for its stability amongst the 16-bit OSes. Microsoft granted the rights to use MS-DOS to all computer manufacturers, which allowed them to customise its name.

Throughout computer history, therefore, we come across names like PC-DOS, TandyDOS, CompaqDOS, and more.



What the earliest DOS programs looked like...

MS-DOS kept evolving by adding support for the 320 KB floppy, non-English languages, networking, then the 720 KB floppy. It added Long File Name support on version 7.0; this removed the eight-character limit for file names. Support for the FAT32 filesystem was added, too. MS-DOS 8.0, embedded in Windows Me, was the last version from Microsoft.

August: The IBM PC!

IBM, the company earlier known for its employee time-keeping machines and punched-card systems, finally decided to foray into

the home computer manufacturing business looking at the success of the Commodore and Spectrum series. The IBM Personal Computer (PC) was truly the dawn of a revolution, and the first of the many computer models it sold. In fact, it was the earliest ancestor of the PC as we know it. Think PC and think IBM... not Microsoft or Intel, at least in the context of history!

The ancestor of the PC we know and love

The team dedicated to the development of this new brand of machines was headed by Don Estridge, now regarded the Father of the PC. They christened the endeavour Project Chess; the project was completed in 1981.

IBM's first PC prototypes were bulky and not considered ideal for the personal computer market. Over generations of models, the PC evolved into one compact unit with customised software. Now here's where the tale took a turn, and here's why we mostly use PCs today rather than, say, Macs: IBM built the hardware in collaboration with Original Equipment Manufacturers (OEMs)—an "open architecture" model. This meant the OEMs could produce peripherals and other hardware that was compatible with the PC, and ensured that as more IBM PC-compatible hardware was available, prices would drop.

The Father of the modern-day PC, Don Estridge

When first released on August 21, 1981, the PC operated on an IBM OS. However, IBM later decided to use Microsoft's DOS, known at the time as PC-DOS, since it was more widely used—despite the original OS being many years

more advanced. This move, needless to say, changed Microsoft's fortunes in later years.

Though the hardware for the IBM PC was "open," the basic input/output system (BIOS) was proprietary. This was done to retain control of the architecture. However, companies like Compaq and Columbia Data Products did rewrite the "ROM-BIOS" of the IBM PC from scratch to produce their own versions of the PC that did not infringe on the patents and copyrights of the original. This lead to an alternative market of PCs priced lower than the original IBM PC.

The IBM PC was the first sewing machine sized machine that was affordable for the masses. Its shape and size were so successful that it become the de facto form factor for PCs as we know them today.

1982
The Processor Wars Begin

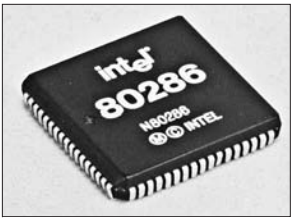
February: The 286

Intel launched its 80286 series of processors in February, 1982. It was commonly referred to as "the 286", and at its fastest speed, was almost twice as fast as its predecessors while retaining backward compatibility.

The 286 was first released at 6 MHz and was later scaled up to 25 MHz, though it was predominantly sold as a 16 MHz processor. It was widely used in the IBM PC and its clones for the next ten years. An estimated 15 million PCs with these processors were sold in the period spanning 1982 through 1989.

The 286 was the first processor designed specifically for multitasking operations, a concept that was gaining ground during this period. It was also the first to provide a "protected mode," wherein multiple applications could compute independently in

separate enclosed segments on the processor. This ensured that one did not overflow to other applications running at the time, which could cause the computer to crash.



The biggest advancement in chip design since the first microprocessor

Intel realised early on that more and more processors on the market would mean decreasing costs and increasing affordability. It therefore sold manufacturing licences to AMD, Siemens, HARRIS, Fujitsu, and IBM, and allowed them to replicate the design and manufacture their own 286es.

August: The Commodore 64—As In 64 KB!

A year after the VIC-20, Commodore Business Machines launched its flagship product, the Commodore 64. Released in August, this personal computer sold at US $595 (Rs 31,500 today). It later dropped its price to $200 (Rs 10,500 now), making it the largest-selling personal computer of all time: it sold 17 million units during its lifetime.

Apart from its attractive price, the Commodore 64 boasted of very good hardware: 64 KB of RAM, and sound and graphics that were better than those of the IBM PC and clones. Another reason for its success was that CBM sold the Commodore 64 at retail and toys and departmental stores apart from electronics stores. It also produced many of its parts and components in-house to reduce costs.

It was popular all right! More than 10,000 commercial software titles were available for the Commodore 64 ranging from office applications to games. The games, of course, are what it is best remembered for.

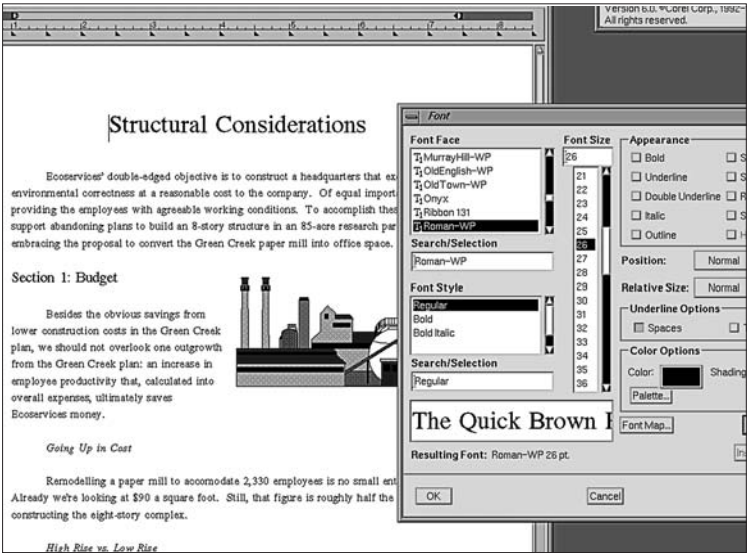

The best-selling computer of all time was as big as a keyboard— and used a TV for output

The demand for the Commodore 64 was high even a decade since its launch. CBM had to finally discontinue the Commodore 64 in 1995, saying its hard drive had become more expensive to make than the entire unit. The company filed for bankruptcy a month later.

WordPerfect: it's Around, But Then There's Word...

Written by Bruce Bastian and Dr Alan Ashton, the founders of Satellite Software International, WordPerfect was originally created for the microcomputers of Data General. It was in 1982 that the authors ported WordPerfect 2.20 to run on the IBM PC, which had sold approximately 50,000 units by then.

The reasons for WordPerfect's popularity were its WYSIWYG editing interface, its vast array of printer drivers, and the ability to work on any computer and OS of the time—like DOS, UNIX, Atari, AmigaOS, VMS, System/370, Apple II, and later Windows, which came out in 1983.



What WordPerfect 6.0 looked like

Viral Infections

The first computer virus, the Elk Cloner, was written by Rich Skrenta, a 15-year-old high school student, in 1982. It targeted the Apple II OS as a boot sector virus. When a computer booted from an infected virus, a copy of the virus was placed in the computer's boot memory. When an uninfected floppy was inserted into this computer, it would get infected with the Elk Cloner. This one was benign: on every fiftieth boot of the computer, it would display a short poem:

Elk Cloner: The program with a personality

It will get on all your disks
It will infiltrate your chips
Yes it's Cloner!

It will stick to you like glue
It will modify RAM too
Send in the Cloner!

Twenty-five years later, today, Skrenta calls it a dumb practical joke.

WordPerfect concentrated too much on DOS, and when it finally released a Windows-compatible version, Microsoft Word had reached version 2.0.

The keyboard shortcuts its customers were so used to had to be different on the Windows platform, since the function keys had a different role. The printer drivers available with the DOS version were rendered obsolete on Windows. Due to these factors and Microsoft's aggressive marketing of its Office Suite, WordPerfect declined in popularity with sales grinding to a trickle.

Word does still have help for WordPerfect users, though!) Corel Corporation later bought over WordPerfect in order to get into the video editing market; WordPerfect was working on such a project.

1983
Lots Of Launches—And A Lame Windows

January: The Spreadsheet Evolves

Released on 26th January 1983, Louts 1-2-3 was a spreadsheet application for the IBM PC and OS/2. It was developed by Jonathan Sachs, who co-founded Lotus Development Corporation. This software was almost a clone of VisiCalc, a popular spreadsheet program of the time. The only difference was that Lotus 1-2-3 was written entirely in assembly language and so was able to perform tasks faster.

The earliest version of Lotus 1-2-3

The "1-2-3" was appended the software name because it offered three basic functions—spreadsheet, charting/graphing, and basic database operations. It also indicated ease of use. The earliest versions had keyboard-driven menus and one-key commands to make frequently-used commands faster to access. It was also the first spreadsheet application to introduce naming of cells, cell ranges and the concept of automatically doing tasks using macros.

Being predominantly targeted at the OS/2 platform, Lotus 1-2-3 was slow to adapt to the Windows platform. A plan to completely re-write the application for Windows, when it became available, failed to take off. Moreover, there were various versions of Lotus 1-2-3 available for Windows, each with slightly different functionality and interface. This further fragmented the customer base of the software. In the next three years, Excel had overtaken Lotus 1-2-3 in popularity.

January: An IBM PC Laptop

Weighing in at 12.5 kg, the Compaq Portable was essentially an IBM PC packed into a suitcase-sized casing; it was announced in January 1983. Since the IBM PC was supported by most hardware and software manufacturers, it was considered a safe buy. There were many manufacturers who released their own versions of the PC but made them compatible with the IBM PC so users could take advantage of the hardware upgrades and software titles available for the platform. The Compaq was the first such completely IBM-PC-compatible PC.

The Compaq Portable: would not fit under a plane seat!

The only way Compaq was able to make an IBM PC compatible PC was because IBM outsourced parts of its computer from other manufacturers and Microsoft licensed the MS-DOS to computer manufacturers. Compaq copied the design specifications of the IBM PC, modified them to fit in a suitcase sized box, and bundled a licensed version of CompaqDOS in it.

The biggest contribution of the Compaq Portable is that it is considered the first truly portable computer, an ancestor of

today's laptops. Though the Osborne 1 (mentioned earlier) is considered the first laptop, the Compaq Portable did improve upon the design limitations of the former.

March: The PC XT

The IBM PC XT (eXtended technology), successor to the IBM PC, was launched on 8th March, 1983, and had a (large) 20 MB internal hard drive. It was targeted at business users and had 128 KB of memory, a 5.25-inch floppy drive, and ran on the Intel 8088 processor. It came with PC-DOS 2.0.

The XT was only an evolutionary upgrade to the PC and was superseded by the IBM PC AT.

The original IBM ad describes the PC XT as "another tool for the modern times to keep you going strong"

May: The Apple IIe

After the launch of the Apple III in 1980, Apple had planned to discontinue production of the Apple II series. However, due to the disastrous performance of the III series, Apple was forced to bring back the II series to revive sales.

Apple's saviour!

After three and a half years of Apple III's launch, the company introduced the Apple IIe, the "e" standing for "enhanced." This series had all the improvements and upgrades of the earlier generations of Apple computers and it offered a few new features.

For the first time, users were able to type in lower-case letters, nor did they have the use the [REPT] key to repeat the same character continuously. The machine also came with 64 KB of RAM, and was about twice as fast as the IBM PC.

The Apple IIe is one of the most recognisable brands of the company, since it was manufactured for 11 years without much change—it holds the distinction of being the longest-lived computer in Apple's history.

November: Windows!

First showcased in November 1983 at Comdex, a computer expo,

True BASIC

The biggest irritant in the BASIC programming language was the adding of line numbers before every line. If you needed to insert more commands after your program was written, you would have to sometimes change all the line numbers. The first BASIC variant to dispense with line numbers, True BASIC was launched in 1983 and appeared on the market in 1985. The main advantages were that it allowed a graphical backdrop to the program, which made it easier for programmers to distinguish between coding elements. It also allowed a rudimentary form of copy-paste called "blitting."

Microsoft Windows 1.0.1 was later to be released in 1985. This was the very first OS from Microsoft to provide a graphical interface, although it was only a front-end to the then-dominant MS-DOS Windows 1.0; it offered limited multitasking capabilities and a graphical interface for DOS programs that were compiled to run on Windows 1.0.

It was for the first time ever that users were able to run two applications simultaneously in a graphical user interface. Multiple windows on the screen were tiled and could not overlap each other. However, dialog boxes and menus could overlap the window. The earliest test builds of Windows 1.0 had pull-up menus that appeared at the bottom of the screen like in DOS, this was changed to be at the top of the screen when the software was finally released. It required MS-DOS to run in the background since Windows 1.0 ran a program called MS-DOS Executive on start up to bring up the GUI interface. Without first installing MS-DOS, therefore, you could not run Windows!

The splash screen of the First Ever Windows!

The system requirements for Windows 1.0.1 were MS-DOS 2.0, 256 KB of RAM, and two double-sided disk drives or a hard drive. The market share for Windows 1.0.1 grew very slowly; users were more than willing to remain on the DOS interface. Serious graphic and DTP work was done on the Macintosh platform.

1984
Enter The Mac

January: The Other Side

Considered a mere toy when launched in January 1984, the Macintosh went on to become a worthy contender to Windows—as you know all too well.

The beige toaster, aka Macintosh (original)

When launched, the Macintosh, commonly referred to as the Mac, had a Motorola 8 MHz processor, 128 KB of RAM, and a custom OS. The Mac did have a fan to cool the CPU, thus resulting in many systems overheating and crashing, giving it the nickname "the beige toaster." The Mac did not have an internal hard drive, but had a crisp 9-inch mono display. The unit had a keyboard without the numeric keys or navigational arrows, and the now-infamous one-buttoned mouse. It sold for $2,500 (equivalent to Rs 1,30,000 now!).

When launched, the Mac came with MacPaint and MacWrite. Software like MacTerminal and MacProject was added later. All these were written exclusively for the Mac GUI. Many users, who were only used to text-based terminal windows, were unimpressed. Application developers too did not initially bother to port their applications to this GUI-rich environment.

August: The PC AT

The IBM PC AT: a worthy successor, but unimpressive nevertheless!

The IBM PC AT was IBM's second-generation series of computers that ran on the 6 MHz 286 processor (mentioned earlier). The PC AT (Advanced Technology) improved upon the protected mode, which we've mentioned earlier, which led to better multitasking capabilities. Under the hood, the PC AT boasted of a 30 MB hard disk, 515 KB of RAM, a 5.25-inch floppy drive, and a full-stroke keyboard with mouse. It ran PC-DOS 3.0 or OS/2 1.x. Despite all this "latest" technology, there quite a few problems: the hard disk and floppy drives were unreliable, and the serial port chip used on the motherboard had a problematic input/output flow. The IBM PC AT was never therefore able to capture dominant market share at the time.

IBM was very protective about its mainframe business. A computer that ran on the 286 and had a faster clock rate was considered detrimental to that business. IBM therefore limited the PC AT to 8 MHz.

August: The Floppy As We Know It

When Sony first introduced this format in 1984, it was not used a lot apart from on its MSX line of computers or on the HP-150 computer. Things started to improve when manufacturers like Apple, Atari, Amiga, Commodore, and ST Line started to choose the format.

The standard 3.5-inch floppy

The construction of the 3.5 inch floppy was better than that of the 5.25-inch ones: it was encased in a rugged plastic body, as you know,

with a metallic, slide-in cover. This prevented accidental contact with the disk surface. The irregular shape meant it could not be inserted incorrectly into the floppy drive.

This format was not without its problems, though. After gradual use, the metallic cover used to bend away from the surface of the disk, causing it to get stuck in the drive or not function when inserted into the computer. This has been improved upon by the introduction of plastic covers that replaced the metallic ones.

August: Better Graphics

Introduced for the first time on the IBM PC AT, EGA was launched in 1984. It included 16 KB ROM which handled all the graphics functions, and reduced the load on the BIOS. This standard was made obsolete with the introduction of the VGA standard in 1987.

1985
Games—Not To Forget DTP

March: Stallman Speaks

The president of the now-very-well-known Free Software Foundation, Richard Stallman, wrote the GNU Manifesto and published it in March of 1985. It was an explanation and description of the GNU Foundation—its ambitions, goals, and principles.

One of the basic principles of the GNU Foundation (GNU is short for "GNU's Not UNIX") is to provide free alternative software for proprietary programs and OSes. The GNU foundation also focuses on advocating the advantages of free software, and is involved in organising programmers to create free software for various OS platforms.

The GNU Manifesto is today used as a reference guide for the Free Software Foundation and its ideas are endorsed by the open source movement.

July: Commodore Strikes Again

After the VIC-20 and the Commodore 64, CMD's next big bet in the computer industry was the Commodore Amiga 1000, launched in July 1985. This computer was originally created for Amiga, another computer manufacturer.

Atari invested the money in Amiga to do the research and development for the Amiga 1000. When it was done, Amiga offered the technology for sale to Atari. When they declined, Amiga approached Commodore, who were more than willing to lap it up.

The Amiga 1000 was initially meant to be a gaming machine with some capability to do other things, and therefore was supposed to have had only 64 KB of RAM. However, Commodore decided to bump up the specs and included a 7.16 MHz processor, 256 KB of RAM, and AmigaDOS 1.3. It sold for $155 (Rs 8,000 now) when launched.

The Amiga 1000 came without a monitor

The First Scanner

Circa 1985, Microtek International Inc. introduced the world's first scanner—a black and white—called the MS-300A, which had publishing software, called EyeStar, bundled with it. This software became the de-facto standard for importing graphics before the TIFF format was envisaged. It would take another 12 years before the first scanner was introduced by the same company.

The Amiga 1000 offered stunning graphics and sound for the time; moreover, the AmigaDOS OS had a GUI that resembled the UNIX GUI and was designed for multitasking. It lost its popularity a year later when its successor, the Amiga 500, was launched.

July: PageMaker For The Mac

In 1985, the art of phototypesetting was not yet fully evolved. What you saw on-screen was not always what you got on paper. Things got a little better when Adobe released its PostScript page description language for the Apple Macintosh. Then Paul Brainerd of Aldus Corporation came out with PageMaker for Macintosh in July of 1985, and all hell broke loose!

The PageMaker software was groundbreaking. For the first time, users could actually create their own art right on the computer. The software relied on Adobe's PostScript page description language and used the Apple LaserWriter, a PostScript compatible laser printer for output. Aldus Corporation released the PageMaker for the PC a year later but by then the Macintosh had already become the de facto standard for a new industry it had helped create: an industry called Desktop Publishing (DTP), which used a computer with page layout software to create documents for publishing.

It was only after half a decade that competing software QuarkXpress started to gain ground on PageMaker. The mystery of why Adobe never released its own DTP software was solved in September 1994, when it bought over Aldus Corporation and with it the PageMaker software.

PageMaker remains available even though it is not marketed any more. Existing customers are now urged to move to Adobe's InDesign software, PageMaker's successor.

August: The OS Called Just OS/2

IBM and Microsoft entered into an agreement to jointly develop a new OS called the OS/2 in August of 1985. OS/2 1.0 was released after two years of collaboration.

OS/2 was very good at controlling the video display and handling mouse and keyboard events. It also incorporated the "protected mode" found in DOS at the time while having the ability to switch between multiple programs running at one time.

The rift between the two companies began to appear as the sales of Windows 3.0 started to increase. By now Windows was bundled with all non-IBM hardware computers, and Microsoft began to divert its resources and funds to future versions of its own OS. There was also an ideological gap between the two companies: while Microsoft was more in favour of the open hardware system approach, IBM was more interested in building software that ran on its proprietary hardware.

Programmers working on OS/2 from the Microsoft and IBM side have written numerous articles on the rift between the two sides. While Microsoft programmers failed to understand why support for the Win32 API was not included in OS/2, the IBM programmers complained about the terseness and lack of comments in Microsoft's code.

OS/2 was withdrawn from sale in 2005.

A screenshot from OS/2 1.0

Now You're Playing With Power!

That was the slogan of the Nintendo Entertainment

System (NES), released in 1985. It was an 8-bit video game console that sold over 60 million units worldwide—and revitalised the gaming industry in America.

Upon launch, the NES included the console, an electronic gun, and a robotic operating buddy. It also came pre-packaged with popular game titles like Super Mario Bros., Duck Hunt, and World Class Track Meet.

Not quite the Wii!

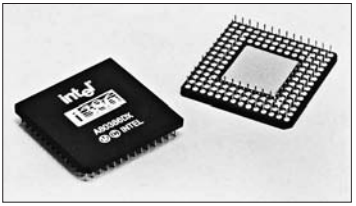
NESes sold like hot-cakes till 1990 until the new age consoles started appearing on the market. The newer consoles like the SEGA Genesis were technologically superior to the NES and its subsequent successor, the NES 2.

In spite of discontinuing production, the popular gaming titles continued to be ported to other generation consoles.

October: The 386

The first 32-bit microprocessor from Intel, the Intel 80386 (the 386) was the third-generation processor in the x86 series. It was launched in October of 1985. The processor ran at speeds ranging from 16 MHz to 40 MHz, and was meant to be a true multitasking chip.

Earlier, chips had been multi-sourced to various manufacturers under licence to mass-produce them; this was to bring down prices. However, in an industry first, Intel decided not



The Intel 386 processor

to multi-source these chips. This move eventually ensured better development of the chip and greater profits. Compaq became the first computer manufacturer to use these chips in their computers. The success of the Compaq 360 was vital in creating the clone PC market and establishing Intel as a major component supplier.

Production of the 386 ceased in September 2007. In spite of its demand begin virtually nil for the PC industry, Intel continued to manufacture these chips for aerospace technology.

1986: Well...

January: Hacking Defined

The now-famous article, *The Conscience of a Hacker*, later called the Hacker Manifesto, was first published in the underground hacker e-zine Phrack. Author, Loyd Blankenship who went by the pseudonym "The Mentor" wrote the small essay on 8th January 1986, shortly after his arrest.

The essay describes the mentality of early hackers and their quest for knowledge which supersedes any intention to harm or exploit people with the use of computer technology.

To this day, the Hacker Manifesto acts as a guide to any newbie and serves as an ethical foundation to the practice of hacking. It also describes that technology should be gifted to the world for free and not governed by multinationals whose sole intent was profit.

IBM Enhanced Keyboard

IBM released the Enhanced Keyboard in 1986. The major difference was that it had 101 keys as opposed to 84 keys on the earlier models of the PC XT/AT. It also contained the navigational arrow keys and control keys. The Function keys were also re-arranged to be on the top of the keyboard rather than on the left.

1987
Chipsets—And Creative

May: GIF Predates JPEG

The Graphics Interchange Format (GIF) was first introduced by Compuserve (the first major commercial online service in the US) in 1987 as an alternative to its B&W-only RLE picture format.

This format used a 256-colour palette and could support animations as well as transparency. It also compressed images using a lossless data compression algorithm that reduced file size. Due to the 256-colour restriction in its palette, it was not targeted at the publishing industry but more towards Compuserve's online repository, which stored images. Reasonably large images using the GIF format could be downloaded faster than those using the PCX or MacPaint, format even on relatively slow connections.

With the increase in popularity of the Internet, GIF became one of the two most popular image formats on the internet, the other being the B&W-only XBM format. The JPEG format only arrived in 1992.

August: Creative Music System

Launched in August 1987, Creative Labs launched its first sound board, the Creative Music System, which provided 12 voices and some noise channels.

The new sound card from Creative Labs—in 1987

This card was unsuccessful and lost out to its rival, Yamaha. The Yamaha card was not only an able gaming card but was also able to synthesise music—something the Creative Music System could not do. Its successor, the SoundBlaster, used the same chip found on Yamaha cards and supported additional features like playing and recording digital audio. Creative Labs used an aggressive marketing strategy, calling the cards "stereo" and incorrectly calling it a digital signal processor.

In spite of these claims, it became a de facto standard for sound cards for many years. In order to protect its position, Creative Labs used to cover the top of their cards in a black or white sheet of paper, presumably to hide the identity of the chips it used. It also used to follow its own method of numbering the chips so that they could not be easily identified.

The SoundBlaster series went on to become the flagship product of the company and the line continues to this day.

December: Again, Not "Real" Windows

Launched on 9th of December, 1987, Microsoft Windows 2.0 was the successor of the earliest Windows version of Microsoft. The capabilities here are said to more closely match up to the pre-release publicity of Windows 1.0...

Notable changes in this version included the ability to overlap windows on one another and inclusion of the "minimize", "maximize", and "close" buttons on all windows as opposed to "iconize" and "zoom" in Windows 1.0. The first Windows versions of Word and Excel also ran on Windows 2.0. The Windows OS reached application critical mass with this version. Moreover, developers of DOS applications started shipping the Windows Runtime software along with their products so that it would run on the OS.

In March of 1988, Apple filed a suit against Microsoft accusing it of copying the look and feel of the Macintosh GUI. This litigation was followed with great interest because the result of the suit would have far-reaching consequences. Observers argued that if Apple won the case, it would hold all the intellectual property rights to the visual graphical interface of any OS. This was in spite of the fact that Apple themselves had borrowed many functions from other, earlier OSes. Other observers argued that by brazenly

The Windows 2.0 splash screen

stealing from Apple's OS, a precedent could be set whereby large organisations could get away with stealing core concepts of a programmer's work. Apple eventually lost all its claims in the lawsuit and was denied a re-appeal to the US Supreme Court in 1994.

Chipsets Enter The Picture

A group of integrated circuits designed to work together is called a chipset. These are normally used to expand the capabilities of the computer and are attached to the motherboard. Before the first chipsets were introduced, the motherboard had dozens of peripheral chips that performed different functions like displaying video, processing video etc. With the advent of chipsets, these functions were increasingly performed by one entity on the board.

Chips and Technologies was the first manufacturer of chipsets. Its first product was an EGA IBM-compatible graphics chip that allowed the earliest IBM PCs to have VGA video capabilities. It also designed a microprocessor for the 386-compatible computers, which were never really popular. Chipsets from companies such as Trend Microsystems and Western Digital were more popular at the time.

The company was acquired by Intel in 1997 for its core business of chip design. Today the chipset market is dominated by audio and graphics chips makers.

1988
A Mish-Mash Of Things

March: The Protocol We Feed On

Introduced around 1974, the TCP protocol today sends packets of data to the intended recipient and re-sends packets that may have been lost in transit. Its other function is reducing the packet size by half when re-sending lost packets. This functionality was not introduced till 1988.

Before 1988, networks used to get clogged frequently when there were too many users at any point of time; packets got lost more often in transit. When the lost packets of the same size were re-sent out, it caused the network to clog all the more. The overhaul of the TCP protocol ensured its robustness and its continued use even till this day.

October: The NeXTCube

A high-end workstation, manufactured by NeXT Computer Inc., the NeXTCube was launched with the top-of-the-line hardware available at the time. It had a 33 MHz processor, 16 MB of RAM, and 256 MB Magneto-Optical drives. Its OS supported Embedded Link Object and multitasking capabilities. The NeXTCube also sold with a very powerful 400 dpi printer.

The NeXTCube impressed many, and was awarded rave reviews by critics. However, it was priced high, and due to its commercial failure, it was abandoned the next year. A few NeXTCube computers are still in use as servers to this day.

Finally... something that looks like a present-day computer!

October: A Computer Reaches Chess Grandmaster Level

By 1958, the game of chess had been computationally mapped. By now it was possible for computers to play chess and beat Grandmasters while they were at it! In 1988, the computers truly dominated the chess scene. The computer DEEP THOUGHT and Grandmaster Tony Miles shared first place in the US Open championship. Later in the year, the computer HITECH won the Pennsylvania State Chess Championship after defeating International Master Ed Formanek. It also defeated Grandmaster Arnold Denker in a match. By doing so, HITECH became the first chess computer to be rated Grandmaster strength.

Grandmaster Bent Larsen became the first GM to lose to a computer in a major tournament—the American Open. By November 1988, DEEP THOUGHT had a rating of 2550, better than any other Grandmaster of the era.

November: First Tablet PC

The Wang FreeStyle was debuted at the CHI'88 computer fair. This was the first tablet PC to be commercially available at the time. It was operated using a stylus instead of a mouse, and had a big monochrome display.

The tablet had a unique file system; files on the OS were not given names. Instead, thumbnails were displayed. Names were only used to identify e-mail contacts. Remarkably, this device allowed you to mash up your data to make it more meaningful; for example, the application called SIGGRAPH'89 allowed users to take a map and draw out a route on it using the stylus while explaining the route in a running commentary. The end document could be mailed out to anyone!

November: The Morris Worm

Robert Morris, a doctoral student at Cornell University, wrote one of the first computer viruses that spread itself via a network. When released, the virus would target VAX and Sun machines. Unlike some of today's viruses, it was not designed to cause harm to the computer: when a computer was infected, the virus would

Faster RAM Chips

Researchers at IBM created dynamic memory computer chips based on an experimental design that could retrieve a single bit of information in 20 billionths of a second. This Dynamic RAM (DRAM) memory was four times faster than the fastest RAM chips available at the time. The engineers also developed an experimental one-million-bit static random access memory (SRAM) chip, which was also the densest chip of its kind.

duplicate itself every 90 seconds. This caused the computers to eventually slow down or crash as the number of virus processes running in the background increased. During this period, the virus would scan for other computers connected to the network and look for security holes in the OS and networks that it could bypass to infect another machine. It also used the sendmail protocol to send infected emails from the host computer.

The virus caused 60,000 computers, including those of military and research installations, across the US to be shut down, causing quite a few heads to turn. The virus pointed out a number of security holes in the UNIX OS that had been discarded as being non-threatening. The worm also reiterated the importance of logs. Quite a few people were not able to find a solution to the problem since they did not maintain logs and therefore didn't know how they were getting infected.

When system administrators started discovering that the virus also used sendmail to send out infected emails, they shut down their mail servers. This caused more harm than good since the virus had other methods of attack and doing so only delayed a chain mail doing the rounds that explained how to remove the virus from reaching affected users.

1989
Chit-Chat

August: IRC

Jarkko Oikarinen, the founder of Internet Relay Chat (IRC), wrote the first IRC client and server at the University of Oulu, Finland, in August of 1988.

Jarkko wanted a system that would hold conversations in real-time and have features of a Bulletin Board System that could dial into computers via the phone line to upload and download data, read news, and send messages. The first IRC server was addressed at tolsun.oulu.fi.

In the meantime, the University of Denver and Oregon State University in the US had begun to run their own IRC servers after getting a copy of the IRC program from one of Jarkko's friends. The three universities combined to form one IRC network. Later on, this network grew even larger to encompass many US universities, the Finnish National Network Funet, and the Scandinavian branch of the network called Nordunet. In a year's time, there were 40 servers worldwide.

Over the years, quite a few IRC networks branched from the main IRC servers. Some of them were EFnet, Undernet, RFC, Dalnet, oz.org, IRCnet and Freenode. The first non-Finnish person to use IRC was Vijay Subramaniam, a student of the University of Denver.

Cyber-crime

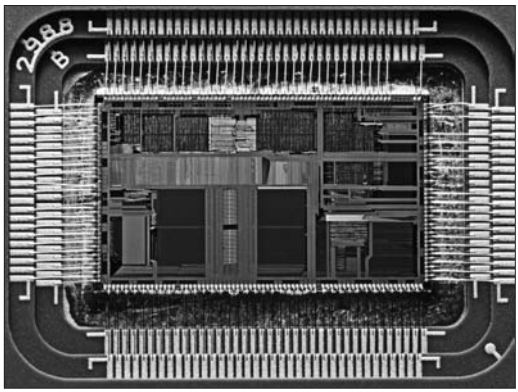
In the first cyber espionage case to make international headlines, hackers in West Germany were arrested in 1989 for breaking into US government and corporate computers and selling the data to the Soviet KGB. Three of them were arrested and a fourth suspected hacker committed suicide. Since the information stolen was not classified, the hackers were only fined and sentenced to probation.

January: The i486

The first line of Intel i486 processors debuted in 1989. These were the second generations of the 32-bit x86 microprocessors and the first pipelined x86 architecture.

The i486 was named thus due to a court ruling that prohibited trade-marking numbers, like the 80486, to be used on products.

This processor was considered near-identical to the 386 with just a few evolutionary updates, the only real difference being its pipelining architecture.



The pipelined architecture of the i486 processors

The i486 was cloned by many other companies. Most of these clones were near-identical to the Intel offering, in spite of it being covered by a number of patents. Later on, the i486 boards also supported plug-and-play features which was used in Windows 95 to make hardware installation easier.

In this decade, it seems, companies were constantly throwing products at the wall and seeing what would stick. It was also an era in which there were quite a few competing technologies vying for market share, and companies that stuck to open standards eventually won the battle.

Mostly, The Internet

The 90's decade in many ways laid the foundation of the PC / Internet-savvy population we are fast becoming. Just as the "Midnight's Children," people who were around when India attained freedom, have a special place in history, a few decades on, the generation that was the first to experience the liberalisation of India will be held in similar awe

The Indian Perspective

As far as decades go with regard to their importance in Indian history, the 90s were almost at par with the 40s... Gaining freedom from the bureaucratic red tape under the License Raj was almost as epochal as gaining freedom from the British.

The then Finance Minister and present Prime Minister, Dr Manmohan Singh, who was instrumental in the process, was probably left with little choice given the fact that India was at the brink of bankruptcy after all the years of hermetic socialism.

The 90s also saw the freedom from state-controlled broadcast media, and for the first time, ordinary Indians had a clutch of channels to choose from. No longer was Prannoy Roy's *The World this Week* the most popular way to get to know what was happening around the world. And finally, Indians, too, were able to undertake journeys into cyberspace for the first time.

From an IT perspective, two major influences brought the PC closer to the ordinary Indian. First, the increased interaction and competition with foreign entities, post-liberalisation, brought home to Indians the need for automation to survive in the market. This resulted in many businesses using PCs for the first time.

Liberalisation also led to increased job and business opportunities, resulting in unprecedented pay packets and increased spending power—which also resulted in more PCs being installed in homes. PCs were no longer seen as an extravagance, rather as a critical investment.

The decade also saw the rise of the tech firms like TCS and Infosys, thanks to the over-hyped Y2K phenomenon, which played a not-so-insignificant role in bringing Indian software coding prowess to the global limelight.

1990
The World Wide Web

May: Finally A Good Windows

The era of Microsoft dominating the PC took off with the introduction of Windows 3.0. It was launched on 22nd May 1990, and rivalled the Macintosh and Amiga on the GUI front.

The biggest advantage of Windows 3.0 was that it could be used with different PC processors and could run on the 80386, 80286, and below. When run on the 386, the speed and stability it offered were unparalleled.

The Windows 3.0 splash screen

Its MS-DOS file manager/program launcher was replaced with Program Manager, thereby simplifying the process of viewing and launching files and applications. Like in the Macintosh, all system settings were relocated to one place on the OS called the Control Panel. All this came bundled with a text editor called Notepad and a simple word processor software called Write. There were two games pre-packaged in the OS—Reversi and Solitaire.

Around 1991, multimedia extensions were released to support sound cards, graphic cards and CD-ROM drives. Microsoft sold more than 10 million copies of Windows 3.0.

September: The Archie Search Engine

The Web's first search engine was Archie. It was nothing like today's Google or Yahoo! or Live Search; it was an archive that catalogued a list of FTP sites and requested for updates once every

month! Launched on 10th September 1990, this system quickly expanded from being a local tool, to being available on a network, to being a popular service available all over the Web. The servers on which Archie was hosted could be accessed by the local client xarchie, to sending queries via e-mail, and later via Web interfaces, like we do today.

The name Archie was derived from the word archive. Clones of Archie— Jughead and Veronica—were, however, inspired by the comic book series.

Then, talking about search engines, we should talk about Gopher, which was created in 1991 by Mark McCahill, Farhad Anklesaria, Paul Lindner, Dan Torrey, and Bob Alberti of the University of Minnesota. Gopher was designed to act as an anonymous FTP service while trying to incorporate new Web features. It contained a file-like hierarchical system that was familiar to users, an easy-to-use syntax, was free to use, and could be created easily.

The name Gopher was chosen because its users would program it to "go for" information.

The Gopher protocol ceased gaining popularity as soon as it was made famous. The primary reasons for this were the University of Minnesota's announcement on charging licensing fees for the use of its Gopher server, Web browsers like Mosaic quickly duplicated Gopher's functionality and finally, because its defined file format and structure was too rigid to use.

December: The Internet Is Born

The Internet was originally envisioned by Tim Berners-Lee, an independent contractor at CERN in 1980, when he created a database software to catalogue people and software models while working at CERN. In this database, each new page of information had to be linked to an already existing page, a term later known as hypertext. He called his software ENQUIRE.

The World

The first ISP on the planet to offer basic dial-up access was The World. Operated by Software Tool and Die, it is headquartered in Brookline, Massachusetts. It used to use the domain name http://world.std.com earlier, but now uses mainly http://www.TheWorld.com.

By 1983, the ARPANET was complete and had a total of 213 Universities connected all over the US. Robert Cailliau joined him in 1990, and the duo tried pursuing CERN to adopt their technology.

By December of 1990, Berners-Lee had built all the required software to run the first Web browser, called the WorldWideWeb, the first Web server, and the first Web pages that described the project. However, the browser ran only on his NeXT system, which was far superior to computers available to the general public at the time.

In 1991, tests were on to make a multi-line text based browser that would run on any computer irrespective of the hardware or OS used. To encourage its use within CERN, they put up the entire CERN telephone directory on the Web. Earlier, users had to dial into the mainframe to get the required telephone number, which could take several minutes.

In May of 1991, Paul Kunz from the Standard Linear Accelerator Centre (SLAC) visited CERN and was fascinated by the Web. He took with him the NeXT software, which was later ported to run on the VM/CMS OS of an IBM mainframe computer. This mainframe contained a catalogue of all the online documents in SLAC. This became the first Web server outside CERN and the first in North America. Then in August of 1991, Berners-Lee posted a summary of the World Wide Web project on the alt.hypertext newsgroup. This was also the time when the Internet became a publicly-available service.

By 1992, early users of the Web were navigating through pages that had HTTP links or hypertext menus presented as a file system. Since the number of new pages was growing rapidly, users bookmarked popular directory pages such as http://info.cern.ch/, or NCSA's "What's New" page. The graphical browser gap was filled in April 1992 with the release of Erwise and ViolaWWW in May. These browsers could view embedded graphics and animation, and paraphrase scripting code. The release of the Mosaic browser in 1993 helped revolutionise the browsing experience.

The first International WWW conference was held at CERN in May 1994. It was agreed that the Web protocol and code could be used by anyone for free. The World Wide Web Consortium (W3C) was founded in September 1994, with Tim Berners-Lee as its founder.

The years 1996 to 2000 saw a dramatic rise of the Web where many companies were starting to offer commercial services—till the 2001 "dot-com bubble" burst.

1991: Enter Linux

June: Pretty Good Privacy

Philip Zimmermann offered Pretty Good Privacy, or PGP, an encryption program, for free download. It offered very high levels of encryption that almost equalled the best proprietary encryption systems. PGP became, and still continues to be, a popular system to encrypt data like e-mail before transmission over the Internet. Zimmermann was motivated to create his program due to the US government move to make all encryption device manufacturers create special "trap doors" in their devices that would allow an encrypted communication, either voice or data, to be accessible in the unencrypted form. The government move was defeated shortly after PGP was made public.

Supercomputing In India

The PARAM 8000 was the first step in India's quest for high performance computing. The 8000 was followed by the Param 9000 and Param 10000, in 1996 and 1998 respectively, with speeds of 2 Gigaflops per second and 100 Gigaflops per second respectively, using the Sun Sparc and Sun UltraSparcII microprocessors, respectively. Most C-DAC supercomputers have been used for managing the environmental data received from satellites, though it is believed that simulations of the second nuclear explosion in 1998 were carried out as well (which led to its blacklisting, along with 98 other organisations by the US government). Supercomputers have been created by other organisations in the country too. The BARC once created a supercomputer for its use, in 1991, called Anupam 860/4, using an Intel 860 microprocessor. Other more powerful versions have followed (Warning : Acronym Overload!) The ANURAG (Advanced Numeric Research and Analysis Group) of the DRDO (Defence Research and Development Organisation) developed the PACE (Processor for Aerodynamic Computations and Evaluation) supercomputer, capable of 8 Gigaflops per second, in 1995, to simulate air flow patterns for Light Combat Aircraft. The PACE PLUS 32, a more powerful version of the PACE, capable of 30 Gigaflops per second, came in 1998, and is used for missile development. HAL (Hindustan Aeronautics Limited) created a supercomputer, the Supersolver (in collaboration with Tata-Elxsi), which uses SGI R8000 CPUs, and is capable of 1.2 Gigaflops.

July: India's First Supercomputer

India's first supercomputer, Param 8000, was created. After the US government denied the export of a Cray supercomputer to India in the 1980s; the C-DAC (Centre for Development of Advanced Computing) was created in 1988 for the purpose of building an indigenous supercomputer. In the span of three years, the Param 8000, based on the massively-parallel processing architecture, had been completed. It was twice as fast as a "serial" Cray of that time—and cost about a third. Incorporating 256 nodes, each containing

an INMOS (a British company) transputer (INMOS named its parallel-processing-capable microprocessors transputers), the PARAM 8000 was capable of a peak processing power of 1 Gigaflops per second. It had 1 GB of RAM and a 20 GB hard disk. The Param used an advanced parallel programming environment called Paras. With Param 8000, India became the fifth nation capable of building supercomputers. Though the design and development were done indigenously, the building blocks—CPU, RAM, hard disks, etc.—still had to be imported. The Param was eventually exported to other countries.

August: Linux Is Born

A Finnish student put out a little message in the comp.os.minix newsgroup informing users of Minix, a UNIX-like operating system, about his attempt to create a free operating system based on UNIX. The student was Linus Torvalds. Within a month the first version of Linus' work was available for download and improvement. The folder from which the code could be downloaded was named "Linux" by the administrator, and this name passed on to the OS. Linus' choice was "FREIX" referring to "FREE" and "UNIX". The first version to be available for download was 0.02.

1992: The First Linux Distro—And GNU/Linux

January: PDA Conceived

Apple Computer chairman John Sculley coined the term Personal Digital Assistant (PDA), referring to handheld computers that typically operate via a stylus on an LCD display. PDAs were intended to improve upon Personal Information Managers, which used to store phone numbers and short memos.

January: ERNET, Internet Starts In India

ERNET (Education and Research Network), a division of the Department of Electronics under the Indian Government, began offering dialup Internet connectivity to premier educational and

research institutions like the IITs, NCST, and IISc. ERNET was tasked with the job of connecting elite organisations involved in education and research. The network itself was also referred to as ERNET. By 1992 all organisations were connected by 9.6 kbps leased line. ERNET users could only communicate with other organisations connected by ERNET and not with the outside world, till 1992, when an international Internet Gateway was commissioned. (A Gateway refers to the connecting point between two networks.) In 1992, ERNET was connected to UUNET in Washington DC through a 64 kbps leased line.

February: First Linux Distro

Owen Le Blanc released the first Linux distribution—MCC Interim Linux. Prior to this, a user had to download bits of the operating system from different sites to be able to satisfactorily use it. Owen Le Blanc offered these essential software as a bundle with the Linux system, so users had an independent system without having to download additional packages. MCC stands for Manchester Computer Centre, where Owen was employed.

February: Version 1 Of GNU/Linux

The GNU/Linux operating system Version 1 is released. It was a fusion of the components that were built for a GNU operating system and the Linux kernel that Torvalds built. Richard Stallman of the Free Software Foundation had been working on the GNU operating system, and all components except the kernel had been completed. The Linux kernel was at the right place at the right time.

May: Gamers rejoice, First FPS Is Made

Wolfenstein 3D, one of the first ever game in the First Person Shooter (FPS) genre, was released by id Software. The game is credited with defining the genre, with activities like pushing switches, collecting health/power ups, finding hidden items, and annihilating all moving characters. The game was not true 3D since characters were flat. The game was distributed as shareware, with the first level being free and the user having to pay to unlock the higher levels.

June: PCI Is Introduced

Intel introduced the Peripheral Component Interconnect (PCI) local-bus standard for personal computer systems. It was made an Open Standard, allowing others to use it without royalties to Intel. It is a 32-bit bus, with an operating frequency of up to 33 MHz, and can support up to 10 devices. The maximum data transfer is 132 MBps. The specifications allowed for a maximum of four PCI expansion slots on a motherboard, since only four Interrupts could be allocated. PCI devices allowed automatic configuration at boot time. The PCI bus eventually replaced other buses, and is seen even today on motherboards.

June: Surfing Defined

Jean Armour Polly coined the term "surfing the Internet." A librarian by profession, Polly wrote a paper under the same title discussing the implication of the Internet for librarians, which was published by the Minnesota university press. This was the first instance of the phrase being used in a publication. Polly authored six books under the series "Internet Kids & Family Yellow Pages," which lists Web sites suitable for children, besides various articles on the subject of the suitability of internet for children. She runs a site, netmom.com, where she is involved in making the net safe for minors.

July: OpenGL API Released

Silicon Graphics and the OpenGL Architecture Review Board officially release the OpenGL 1.0 Specification. OpenGL is a graphics API used most popularly in game development. Unlike the other graphics API, DirectX, OpenGL is platform-independent. Popular OpenGL games include *Doom* and *Quake*.

1993: Plug And Play And Pentium

March: PnP Introduced

Microsoft introduced the Plug and Play initiative. This refers to the ease with which new components (Plug-and-Play-compatible) could be added to a system. For Plug and Play to be successfully implemented, three components have to interact—the device that is plugged in, the BIOS of the system into which it is plugged, and the operating system.

Any new device connected to a PC would report its specifications to the system BIOS allowing for allocation of resources (like Interrupts), and searching and installation of appropriate drivers by the operating system without requiring user intervention. Compaq Computer, Intel, and Phoenix Technologies were the initial supporters.

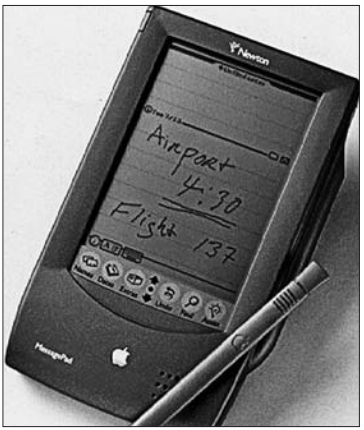
March: The Beginning Of The Pentium Era

Intel released the 3.1-million-transistor Pentium processor. Architecturally, the Pentium doubled the width of the data path compared to the i486, from the memory to the processor, to 64 bits, and could complete 2 instructions per clock cycle. Vinod Dham was the lead designer of the team behind the Pentium, and the title of Father of the Pentium is usually attributed to him.

April: First GUI Browser Takes Internet By Storm

Marc Andreessen and Eric Bina created the Mosaic Web browser, the first graphical browser, at the National Center for Supercomputing Applications, University of Illinois. It was originally created for the UNIX platform; Apple and Windows versions came by the end of the year. Before graphical browsers came into the picture (no pun intended), text browsers were the only way to surf the Net, and these were unable to open images embedded in the text. The popularity of the WWW exploded after the arrival of Mosaic. The Mosaic code was licensed to other browser manufacturers, including Microsoft, who used it to built their Internet Explorer.

August: The Apple PDA



The Apple Newton OMP

Apple Computer launches the Original Newton MessagePad personal digital assistant. It is considered the first PDA. Besides supporting basic personal information management functions like address book, calendar, organiser, and note taking, it had a 9600 kbps modem that allowed e-mail and fax, and included a handwriting recognition feature allowing text to be entered by writing with the stylus on the touch-sensitive screen.

1994: Yahoo The Directory

January: Yahoo! Begins

Yahoo! was founded. Originally called "Jerry and David's Guide to the World Wide Web," it was a directory created by Jerry Yang and David Filo of the many sites on the Internet. The project started off as a personal list of favourite Web sites. The exclamation mark in the name was necessitated since the name "Yahoo" had already been trademarked. By the end of the year, the site was receiving a million hits a day. The company was registered in 1995 and was listed on the stock exchange in 1996.

May: Netscape Communications Formed

Jim Clark (co- founder of Silicon Graphics) and Marc Andreessen (co-creator of Mosaic Web browser) incorporated Mosaic Communications. Due to legal tangles with the University of Illinois over the "Mosaic" name, they were forced to change their name to Netscape Communications. The Netscape Navigator

browser was their first product. In 1998, Netscape was bought by AOL. In the same year, it made its browser code open source, which formed the basis of the present Mozilla browser.

May: First Virus Writer Punished

In England, 26 year old Christopher Pile became the first person to be jailed for writing malicious code. Pile, besides spreading the Pathogen virus to virus makers on the Internet, also infected benign programs—including a virus checker!—that could be downloaded and run by unsuspecting users. Pile was sentenced to 18 months in jail.

1995: Java, DirectX, Dialup

May: Sun's JAVA Programming Language

Sun Microsystems introduced the Java programming language. The language that ultimately ended up being called Java in 1995 started off as "Oak" in 1991 for use in a TV set-top box. Creator James Gosling intended to create a platform-independent language that could be used in consumer electronics devices, specifically for the cable TV industry. While there were not many takers in the target market, the spread of the Internet in the 90s presented an unexpected opportunity. The capability of the language to be platform-independent proved to be a boon, since different platforms were being used to connect to the Internet. Java's popularity exploded once Netscape, the most popular browser in the early years of the Internet, began supporting it. Applets—small programs written in Java—are presently seen liberally on sites in different forms, ranging from stock tickers to games.

A Java program requires the Java Runtime Environment to operate. While the program itself is the same, the Runtime varies with the platform—and this allows the same program to be run on all platforms, as long as the relevant Runtime environment is installed.

July: Amazon.com Is Born

Jeff Bezos launched "Earth's largest bookstore"—Amazon.com. Though Bezos founded the online bookstore in 1994, the site went online for the first time in 1995. It was initially named cadabra.com.

August: VSNL Starts

VSNL began offering Internet services to the general public in India. VSNL's Gateway Internet Access Service was first available in the four metros—(then) Bombay, Delhi, Calcutta, and Madras. The first plans on offer were a 9.6 kbps dialup connection, and 9.6, 64, and 128 kbps leased line connections. VSNL only had 100 dial-in lines to start with, and it was connected to its international partner MCI with a 128 kbps to 2 Mbps link.

September: NVIDIA's First Card Released

The NV1, NVIDIA's first graphics card, was released. Besides a graphics core, it also had audio playback capability and a Sega console connector. This allowed Sega games to be played on PCs. Shortly after it was released, Microsoft announced the development of DirectX which used a different graphics rendering methodology. This quickly made the NV1 untouchable!

September: DirectX Launched

Microsoft released DirectX 1.0. It was created to compete with OpenGL, which already was in use. DirectX includes APIs like Direct3D, responsible for all graphics instructions, and DirectSound, responsible for audio instructions.

September: RedHat Created

Red Hat Software was created by merging Bob Young's ACC Corporation (started in 1993), which was involved in selling Linux-related books and accessories; and Mark Ewing's Linux distribution business (started in 1994), which was selling a Linux distro called Red Hat Linux. Red Hat Linux version 2, the first one released post-merger, introduced an easy way of managing installation and removal of applications from the Linux system, called RPM (RPM Package Management).

November: USB Comes Along

The Universal Serial Bus (USB) was introduced. It was intended to offer a single interface for connecting a myriad devices, unlike the existing types of ports (Serial, Parallel, PS/2, etc). Up to 127 devices could be connected to a single USB controller, and devices could be installed and uninstalled without rebooting the PC (such devices/interfaces are called "hot swappable"). Version 1 allowed a maximum data transfer rate of 12 Mbps.

December: Apple Introduces FireWire

The IEEE 1394 standard was adopted. The result of research at Apple Computer, who also gave it the name "FireWire", the proprietary specification became an industry standard after it was adopted by the IEEE—The Institute of Electrical and Electronics Engineers (by document number 1394, which resulted in "IEEE 1394" being used to refer to FireWire). The maximum transfer speeds in the first version was 400 Mbps . It was also used by Sony under the iLink name.

The Internet In India

Before VSNL offered dialup Internet access to the general public, other government bodies were already offering Internet access on a limited scale. ERNET (Education and Research Network), NIC (National Informatics Centre) and STPI (Software Technology Parks of India) were the first ISPs in India. NIC was entrusted with networking different government offices to aid administration. The primary use of the network was exchange of information within the country. NIC offered Internet connections only to these connected offices. STPI was a government body created to encourage and develop export oriented IT firms, and offered all services needed for such firms at a single place. Internet connections were available to only those firms that registered with STPI. VSNL was the first to offered Internet access to the general public. After the Government liberalised the telecommunications policy, private ISPs also allowed to set up shop. The first private ISP was Satyam Infoway, which started operations in Hyderabad in 1998.

1996: Hotmail!

March: Javascript Implemented In Netscape

Netscape Communications released JavaScript. Netscape Navigator 2 was the first browser to implement it. JavaScript allowed sites to be "dynamic," or interactive, for the first time. This was possible because the JavaScript in the page could be executed at the client end in the browser without having to contact the server and reload the page. After the launch of JavaScript, websites sporting cursor trails and scrolling text became quite common; but there were many more serious uses as well, like checking the validity of an input before it was sent to the server, to save time and bandwidth. The language, when launched, was called Livescript, but since "Java" had become popular, and because they have somewhat similar code elements, the name was changed to JavaScript. It was standardised by the ECMA (European Computer Manufacturers Association) in the same year.

July: Hotmail Goes Live

Hotmail, founded by Jack Smith and Sabeer Bhatia, was officially launched. It was the first free Web-based e-mail provider, as opposed to ISP-offered e-mail, which was prevalent. The founders had met when they were employees at Apple Computer.

September: Thin Clients

The Network Computer (NC) concept was introduced by Oracle and Sun, among others. Intel and Microsoft did not support it, and quickly followed with the similar NetPC concept. Neither of these concepts were novel; they were similar to the older Thin Client concept. It envisaged a system of computing where a central server stored all data and applications and was connected to client PCs that did not have a hard disk. The client was called a Network Computer/NetPC. The advantages were that a user did not have to invest in expensive operating systems and application software for every client, and could access these from the central server when needed. Organisations were already implementing the Thin Client concept to save costs; the difference was that the Network

Computer concept intended to use the pervasiveness of the Internet to cater to a larger audience.

The concept did not meet with much success since the cost of PCs reduced and Internet connection speeds were not high enough to avoid long waiting periods as data was being transferred from the server to the client.

November: First All In Wonder

ATI released the All in Wonder range of graphics cards, which, besides including a 3D processing core, also had a TV-Tuner and video capture capability. It is recognised as one of the first of its kind.

1997: Processors, Processors

March: Apple Buys NeXT

Apple Computer acquires NeXT, a company founded by Steve Jobs. The Unix-based NeXT operating system became the foundation for the next Macintosh OS. Steve Jobs was appointed Advisor to the CEO at Apple Computer.

April: AMD's K6

The sixth-generation AMD K6 CPU was released. It offered almost at-par performance as similar Intel offerings, but cost less and could be plugged into motherboards built for the Intel processor, thus presenting a serious challenge to Intel for the first time. The K6 had 8.8 million transistors.

May: Deep Blue Beats Gary Kasparov

IBM's Deep Blue became the first computer to beat a reigning World Chess Champion, by beating Gary Kasparov. Kasparov had prevailed in their previous encounter. Deep Blue, built around a 32-node, IBM RS 6000, high-performance computer, had 256 dedicated chess processors capable of analysing up to 200 billion moves in three minutes. The six-match tournament ended with two matches in Deep Blue's favour and three draws.

The CPU Wars

At the start of the decade, Intel, AMD, Cyrix, NexGen, Motorola, IBM, Texas Instruments, SGS-Thomson, and National Semiconductor were players in the CPU market.

Intel was and continues to be the dominant player. Over the 1990s, Intel developed and released faster and newer versions of its processors at regular intervals. The fifth-generation processor, the Pentium, was out in 1993; the Pentium Pro in 1995; the Pentium MMX and Pentium II were released in 1997; the Pentium III followed in 1999; and the Pentium IV landed up in 2000. Besides these, Intel also made processors for Servers (Xeon), portable PCs (Mobile Pentiums), and Budget PCs (Celerons).

AMD played the underdog to Intel throughout the most of the decade, and was the only real challenger. And, towards the end of the decade, it had even begun to challenge Intel's dominance. AMD's processor releases quickly followed Intel's, and they were usually cheaper than the Intel counterpart. Up to the fifth generation, AMD was only preparing Intel CPU clones, which was cause for litigation with Intel accusing AMD of patent violation with regard to the use of its microcode.

The fifth-generation AMD CPU, labelled the K5, was released in 1995, and was entirely an AMD product. Things truly picked up with the sixth generation: in 1996, AMD merged with chip manufacturer NexGen. The processor NexGen had been working on prior to the takeover had a better design than AMD's own processor. The K6 was based on the NexGen design. The K6 series of processors that came out in 1996 were considered at par with the equivalent Intel processor, besides being cheaper. The K6-II and K6-III upped the ante in the processor war with some of them beating the contemporary Intel product. With the seventh generation Athlon series of processors, which was a result of collaboration with Motorola, AMD surged ahead. The landmark release of the first CPU to breach the 1 GHz barrier was a natural progression.

Cyrix was primarily a chip designer and did not have manufacturing facilities of its own. It initially used the facilities of SGS Thomson and Texas Instruments—and later IBM. Though it did release processors that catered to the low energy consumption niche, especially portable PCs, the significant performance deficiency proved unattractive. Cyrix was bought by National Semiconductor, which later sold it to Via Technologies, a maker of computer chipsets. The Via C3 processor is based on a Cyrix design.

Motorola was also a CPU manufacturer, supplying IBM (PowerPC CPUs), Apple Computers (G4 CPUs) and Commodore (Amiga computers).

December: Microsoft Buys Hotmail

Hotmail was acquired by Microsoft for $400 million (Rs 1,800 crore). At the time, there were about 8.5 million Hotmail users. Hotmail's infrastructure, which was Solaris-based, continued to power the site till the end of the millennium.

1998: Goooooooogle

February: Open Source

The term "Open Source" was coined. The Open Source Initiative was formed by Bruce Perens and Eric Raymond as an alternative to Richard Stallman's Free Software Foundation. Open source software licensing terms are not as restrictive as those of the Free Software Foundation's GPL (GNU Public License). Open source licensing allowed software that was not entirely free to be used along with free software, which was something the FSF did not permit. Netscape's browser code was made open source , but was not licensed under the GPL. The launch of OSI coincided with the opening up of Netscape's code.

May: Pretty Apples

Apple Computer began shipping the iMac G3 (this was the first iMac, despite the "G3" connotation). Designed by Jonathan Ive, the iMac had just three sub-units—the monitor, the keyboard, and the mouse. The components that usually constitute the cabinet in the ordinary PC were incorporated into the iMac's monitor. It was the first Desktop computer to do away with a floppy drive, and the first Macintosh to use USB. The "i" in iMac referred to the Internet, since Apple wanted to emphasise the ease with which a user could go online with the iMac. It was powered by a 233 MHz Power PC 750 processor.

The Pretty iMac

The Browser Wars

Graphics-capable browsers are responsible for the explosive growth of Internet users ever since the Internet became publicly accessible. Netscape Communications, which was the first to enter the arena, captured the lion's share of the browser market, estimated at a high of about 80% of all users in 1996. Microsoft used the code of the Mosaic browser—which had been co-created by the co-founder of Netscape—in its Internet Explorer, but it did not see the potential of the Web initially, and was slow in pushing its browser. Once it got its act together, it used to its advantage the fact that Windows held more than 90% market share in the operating system market. Microsoft offered Internet Explorer as a free download for all Windows users, while Netscape still charged for its browser (version 4 was the first to be given totally free; earlier versions were free for private users only). Before Windows 98, Internet Explorer was available as a distinct package (Windows Plus package) that had to be separately downloaded and installed. But IE became an integral part of Windows 98 making it the "default" browser. This put Netscape at an disadvantage simply since it required downloading and installing. Besides this, Microsoft was also able to extract commitments from AOL and Apple to use IE as the default browser. While the browser war lasted, each company were quick to launch product updates without adequate quality control... IE4 is credited with winning the war for Microsoft, and it is acknowledged to have implemented W3C specifications with more fidelity than did Netscape 4. By the end of 1998, IE had gained the upper hand.

September: Here Comes Google

Larry Page and Sergey Brin founded Google. They met when they were students at Stanford University. The precursor of Google was a program they created, called BackRub, which analysed back-links to a Web page. (A back-link is the link to it from an external page.) Their experiments with BackRub resulted in the algorithm called PageRank, which used back-links to segregate Web pages based on relevance. The present form of the algorithm consists of 500 million variables and 2 billion terms. Initially, though

BackRub gained a lot of word-of-mouth publicity, there were no takers for the Google service. The first encouragement they received was a $100,000 (about half a crore) cheque from one of the founders of Sun Microsystems. Commercially, the first breakthrough came when Google was selected by AOL as the search engine for its site. Google's index quickly grew to include 1 billion Web pages by 2000. "Google" is derived from "googol," which refers to a number that has one followed by a hundred zeros.

An early Google search page

1999: Napster... What Else?

March: Melissa Causes Havoc

The Melissa virus infected about a million PCs worldwide. Melissa was a Microsoft Word macro and mass e-mailer virus that appeared as an e-mail with a Word document as attachment. Once opened, it used Microsoft Outlook to mail itself to the first 50 addresses in the address book. It was the first virus capable of jumping from computer to computer on its own. Creator David Smith was tracked down and arrested a week after the virus was first noticed.

March: GNOME Released

GNOME, a Desktop Environment for Linux, was released. Development on an alternative to the KDE Desktop Environment was precipitated due to the fact that KDE included proprietary code, and could not be licensed under the GPL. Started in 1997 by Miguel de Icaza and Federico Mena, it did away with the proprietary Qt widget toolkit that was the underpinning of KDE, and used the GTK toolkit, which was free.

March: Pentium III

The Pentium III was released. It had 9.5 million transistors, and improved upon the Pentium II by increasing the number of instructions to handle graphics load. The inclusion of a unique serial number in the processor that could be accessible over the Internet proved a controversial issue.

May: Napster Popularises P2P

And then 18-year-old Shawn Fanning created a program that allowed users to search for and share content on the Net. The program, called Napster, popularised the Peer to Peer (P2P) mode of file sharing. P2P was not pioneered by Napster; users had been using IRC (Internet Relay Chat) channels to do the same much earlier. But Napster, thanks to the client's user-friendly interface, is credited with making P2P hugely popular.

June: AMD Beats Intel With Athlon

AMD released its Athlon processor. This seventh-generation processor, after the K6 series, was aided by a collaboration between AMD and Motorola. For the first time, the AMD product was undisputedly superior than the Intel offering. It had 22 million transistors.

Ridiculous Domain Prices

Mark Ostrovsky sold the domain business.com for $7.5 million; in 2007, the domain was resold for $360 million. The InterNIC, the domain registering body of the Internet, allowed domains to be registered on a first-come-first-served basis. This allowed people to register domain names that were similar to the names of pop-

Napster

Shawn Fanning was motivated to write a program to aid finding and downloading music files because the existing methods were not satisfactory. The reasoning behind the project was that files that exist on one user's PC could be of interest to another user. Shawn's program combined Windows' file sharing program with IRC's chat capability and incorporated a search engine. The name refers to a nickname that Shawn was called by when in school. Convinced there would be a lot of demand for this service, Shawn's uncle helped him incorporate the venture, and they were also able to attract investors.

Though the files per se were stored on users PCs, the servers at napster.com tracked the details of the files (millions of them) that were being shared. The explosive spread of the service's users made Shawn famous (he was even interviewed by Time Magazine), though this also (naturally) attracted the attention of the Recording Industry Artists Association (RIAA), the body representing musicians and record labels. End-99, accusing Napster of encouraging piracy, RIAA filed a lawsuit requiring Napster to remove, from its servers, users sharing copyrighted music. The first lawsuit failed, and all the media attention further fuelled Napster's fame and contributed to an exponential increase in its users in the final months before the service was stopped. About 60 million users were reported to have used Napster in its heyday.

Napster made the Peer to Peer mode of file sharing popular, and spawned many other such networks, including Gnutella (which was launched in the year 2000 with the support of the maker of the popular media player Winamp, Nullsoft, though it withdrew support to the development quickly after), BearShare, Morpheus, etc. These clients were different from the Napster type of P2P—they did away with a central server, making it much more difficult to completely close down a service.

Napster was eventually forced to stop operations in 2001 by another court ruling and was eventually liquidated in 2002. In the liquidation auction, Roxio (makers of a popular media editing and playing software) was the buyer. Napster was re-launched as a paid service, but by that time, there were many players in the field—like iTunes.

ular entities before the latter could, and then sell it to the needy parties at a higher cost than that charged by InterNIC. This activity, called Cybersquatting, was curbed when the courts ruled that trademarked names were out of bounds for cybersquatters. But "business" was not a trademarked word. The buyer, ecompanies, was (is) a venture capitalist.

The Y2K bug

Though commonly referred to as a bug, technically it isn't one. Early programmers consciously used only two bits, rather than four, to represent a year to save memory. So rather than record a year as 1974, programs recorded "74". And since memory was at a premium, the savings were welcome. In the year 2000 (or Y2K), these programs would only consider "00", rather than "2000". It is easy to see that calculations involving dates in the different millennia would have erroneous results. This issue effected all software programs as well as all devices using embedded chips with firmware that used the 2-bit limitation. It was feared that when the new millennium arrived, chaos would reign since computers and embedded chips were pervasive. The solution involved going through programs' source and finding the areas where the date field was set to 2 bits and changing it to 4. Due to the pervasive nature of the problem, there arose a strong demand for computer engineers. Since most of the old programs were coded in languages like COBOL and FORTRAN, people who had experience in these were in much demand. Engineering students in India were still being taught these languages as part of their curriculum, and found themselves in an ideal position.

In many ways the Indian IT companies found the Y2K phenomenon advantageous since it offered a great opportunity to showcase their coding skills.

The New Millennium

Here we'll detail the notable events that happened in computing between the years 2001 and 2007. Over the past seven years, technology has jumped forward considerably; however, instead of reinventing the wheel, we seem more inclined to perfecting existing technology. Every single one of you reading this book has lived through the events we detail here, and will agree that this is the decade of innovation, not invention—where a good idea *uses* technology to become a success, rather than the technology *being* the idea.

2000
The Dotcom Bubble

January: Jobs returns to Apple

Steve Jobs was appointed full-time CEO of Apple Computer. After having been chucked out of the company more than a decade earlier, Steve Jobs had started NeXT, which was ultimately bought by Apple.

January: The Transmeta Crusoe

Transmeta launched the x86 processor Crusoe, focusing on energy efficiency. The first processor was the 700 MHz TM3120. Unlike the leading players like Intel and AMD, Transmeta's CPU offered significantly lower performance at the same clock speed. But consider that it consumed only 10 per cent of the power! This made it ideal for laptops where battery backup time was a crucial factor. While the company did not make significant inroads into the Desktop PC market, it did help in focusing attention on the issue of power consumption, and ratios like performance per watt.

The Dotcom/Internet Bubble

From mid-1998 to mid-2001, the NASDAQ, an index that tracks mostly technology stocks, went from the 1500 level to a peak of 5000 in mid-2000 before plunging back to the 1500 levels a year later. This period is referred to as the Dotcom/Internet bubble, since most of the stocks that saw the sudden increase and equally sudden decrease in their stock prices were those of Internet-based businesses.

After the release of the first graphical browsers - Mosaic and Netscape - the popularity of the Internet grew exponentially. A new breed of entrepreneurs realised the business potential of the internet, and the convenience of doing business on the Internet. It was feared that dot-coms would lay to waste all businesses in the real world, referred to as brick-and-mortar companies. Many reasons are proposed to explain the sudden spike in investor interest in online company stocks. Since the Internet was a new medium,

The Graphics Card Industry

The 1991 to 2000 decade saw the establishment of the PC as a viable entertainment platform - games as well as movies. While consoles from Atari, Nintendo, and Sega were popular in the first half of the decade, with PCs becoming more affordable and the number of homes with PCs increasing, towards the end of the decade PCs had become a force to reckon with.

Graphics cards that existed at that time were primarily for 2D graphics, since 2D was being used by high-end workstations. Video games used 3D graphics, and this created a different market segment. Factors that influenced the graphics card industry included the release of PC-only games like ~Quake~, the introduction of the AGP interface, and the introduction of DirectX as a major graphics API in a market with many proprietary graphics API like 3dfx's Glide.

3dfx was the first graphics card manufacturer that released a card specifically for gaming, in the form of the Voodoo, in 1996. Being unable to deal with 2D load, systems required a separate graphics card in addition to the Voodoo, but the card proved popular nevertheless. 3dfx saw considerable success with every version of the Voodoo series. The last in the series was the Voodoo 5.

NVIDIA, whose first chip, the NV1, used a different graphics rendering method from that supported by DirectX, had to create an entirely new design that was released as the Riva 128. NVIDIA followed this up with the Riva TNT, and then the Riva TNT2... then the GeForce 256 and GeForce 2 families. The Riva TNT2 proved too good a match for the 3dfx Voodoo 2, and helped NVIDIA become market leader. In 2000, NVIDIA took over 3dfx.

Through these years, ATI released the Mach and Rage series of graphics cards which helped it to maintain its position in the market. This situation changed with the Radeon series, when it began challenging NVIDIA.

Besides these, there were others like Cirrus Logic, S3, Matrox, SiS, Intel, and 3D labs. S3 was acquired by Via and their know-how was used to create onboard graphics for Via chipsets; Intel and SiS gave up their pursuits in the field of discrete cards and focused on offering onboard solutions. Matrox focused on 2D graphics.

people were not sure what direction it could take, and so were willing to take the additional risk to be part of the impending gold rush. The usual yardsticks employed to assess the attractiveness of brick and mortar company stocks were not used in case of the dot-coms. Mass media played a role in creating the hype surrounding the new age entrepreneurs. In any case, companies with little or no prior experience and those who lacked any practical business plan were able to attract investment from the public. Many company stocks were quickly overvalued, making the investors and the founders rich, at least on paper. Companies like Netscape Communications saw their stock prices increase manifold overnight making billionaires of their founders.

The reasons for the bursting of the bubble is, again, not clear... After the smooth passage into the new millennium, companies that had invested in redundant hardware as a precaution against the effects of the Y2K phenomenon were not giving any more orders. The outsourcing phenomenon had also begun to dig into investor confidence. In any case, once investors began to realise that the stock prices were overvalued many times over, the selling began. Companies that were the toast of the town suddenly declared bankruptcy (like Pets.com); many were bought out by more capable buyers (Netscape was bought by AOL); the rest scaled down to a more practical and realistic level. It is estimated that with the burst of the bubble, approximately $1.75 trillion (Rs 84 lakh crore) in market value was lost.

2001
The Year Of The iPod, Windows XP And Xbox

January 1: Out, 95

The first day of the year, Microsoft announced that it would no longer be shipping Windows 95 to customers. They termed the ageing OS a "legacy item," which is a lot less than we would say if given the chance! Anyway, this move was expected as later the same year Microsoft would release Windows XP.

January 6: The Xbox

Microsoft unveiled the final version of the Xbox to the world. Bill Gates himself did the honours at CES Las Vegas, and pulled back the curtain on Microsoft's venture into the gaming console arena. This was quite an important event in technology history because it marked the beginning of a heated battle between Microsoft and Sony in terms of gaming consoles—a battle that rages on even today.

Here an image of the Xbox released to the press, back in 2001

January 15: Intel and Xircom

Intel announced that it would buy over Xircom Inc., a company best known for connectivity solutions for mobile devices. Xircom also marketed memory cards, LAN adapters and modems. After being acquired by Intel, Xircom produced CompactFlash connectivity devices such as Ethernet and modem adapters for handheld devices. Intel continued to sell networking products under the Xircom name for a long time, till October 2005.

March 24: Cheetah

Apple released Mac OS X (v10.0), codenamed Cheetah. Unlike what

we know of Apple software these days, Cheetah was slow and lacked a lot of features. Critics opined that it was an OS that was not near ready for release. Being a complete platform up from Mac OS 9, and not just another upgrade, the release also meant that OS X had little or no compatible applications available to early adopters—another rather large bee in the average computer user's bonnet. However, Apple is notorious for having fans that vociferously defend its every move, and the early release of OS X was widely applauded by fans. As you will read later, Cheetah was soon followed by Puma (v10.1) in September 2001.

March 31: Quantum—Maxtor—Seagate

Quantum, once one of the biggest hard drive manufacturers, announced that it would be selling its hard drive business to Maxtor. At this point in time, there was a raging battle in the hard drive segment, with companies trying to outdo each other on prices. This cut-throat nature of the competition prompted Quantum stock holders to vote positively towards the decision to get out of the end-user hard drive segment and focus on tape and other media still popular with the corporate. Interestingly, not much later (in 2005), Maxtor itself was bought over by Seagate, and the price battle in this segment continues even today—which is a great thing for we the end-users.

April 11: Clippit—get off my document!

Microsoft announced that future versions of MS Office would no longer include Clippit—the animated paperclip that used to pop up when you were writing something in Word and said, "It looks like you're writing a letter. Would you like help?" Microsoft even made ad cartoons, making fun of Clippit and announcing that Office XP onwards it was curtains for Clippit. Of course, Clippit was present in Office XP, and was just disabled by default, so the seven fans of Clippy in the world could turn that feature back on again if they desired. In Office 2003, Clippit wasn't installed by default, but if you had the MS Office 2003 CD, you could choose to install him. It's only with Office 2007 that Clippit was actually removed, and that there was no way to install him. Watch the car-

toon ad videos of Clippy on YouTube:

www.youtube.com/watch?v=rBO3aRifPLU
www.youtube.com/watch?v=uJCv8ru3L98
www.youtube.com/watch?v=sMShkAZR1-Q

April 20: Dell's big

A typical online gambling site

Dell officially took over the title of "World's Largest PC Manufacturer" from Compaq. This is a significant point in branded PC history because it was the first change of the crown in over seven years. Compaq ruled the roost from 1994 to early 2001. Before that, IBM was on top from 1991 to 1994, and just for the year 1990, Apple found itself to be the world's largest PC maker. In more recent history, we've seen HP and Dell, then HP-Compaq and Dell swap the crown between themselves. However, the toppling of Compaq's seven-year reign (the longest ever) is something that we're sure puffs up Dell employees' chests to this day.

June 4: Online gambling

Nevada becomes the first US state to legalise online gambling. This event saw a huge boom in online gambling sites, because it now meant that such sites could be hosted on US soil. Although Internet users can come from anywhere on the globe, the legality of the site only comes into question based on where the site is hosted. Before this legislation was passed, most online gambling sites were hosted in Europe, where the laws against gambling are much softer. Online gambling continues to be a big industry, with most of the bets being placed from US-owned IP addresses and accounts. Laws in the US are still unclear about online gambling, since no law of any state prohibits it—though offline gambling is prohibited in most states. It seems apt that Nevada, home to Las

Vegas, was the first to legalise and regulate online gambling. Incidentally, hosting an online gambling site back in 2001 meant coughing up half a million dollars in license fees and then $250,000 every year afterwards!

August 29: SATA

The Serial ATA specifications were released at the Intel Developer Forum (IDF). Serial ATA (SATA) would eventually replace Parallel ATA (PATA) as the standard for connecting devices to the motherboard in the average home PC. Advantages include higher bandwidth, smaller connectors, fewer pins and thinner cables to make the insides of our cabinets more manageable, also improving motherboard design and making in-cabinet heat dissipation simpler. Currently, the most popular interface is revision 2 of SATA, which offers 300 MBps transfer rates.

September 6: The HP-Compaq deal

Hewlett-Packard (HP) announced that it planned to buy Compaq in a stock-for-stock deal that would cost them about 25 billion dollars (1 lakh crore rupees). This deal made HP-Compaq the largest PC manufacturer in the world, and also the world leader in printing solutions.

September 25: Puma follows Cheetah

Apple followed up Mac OS X 10.1 (Cheetah) with 10.2 (Puma). This upgrade was significantly better than Cheetah, and brought with it better performance and filled in the cracks in Cheetah—DVD playback being the most important. A significant visual change also occurred, when the start up screen saw the death of the "Happy Mac" icon to a prettier and more sober grey Apple start up icon. The Happy Mac icon was something Apple users had seen at their start up screens for over 18 years—aeons in terms of technology businesses!

October 23: The day of the pod

Apple announced the release of its portable media player called the iPod. Today, the iPod remains the highest-selling portable

media player to date, and is Apple's flagship product. As of 2007, Apple has sold over 110 million iPods across the globe. It has also sparked an entire market of its own, with manufacturers from across the globe making iPod accessories. The iPod is such a common site across the US that the term iPeople was conjured up to describe the millions walking around with ears plugged, dancing to the music their iPods belted out. Need we say more?

The first generation of iPods

October 25: XP

Microsoft released the next version of their operating system, Microsoft Windows XP. The Windows XP Professional and Windows XP Home flavours were released first, with subsequent versions to follow. This was the first time Microsoft was making many versions of the OS for end-users—it was earlier just a distinction between server and end-users. It also meant that people would have to choose more carefully what they were buying a computer for, and pick between Windows Home and Professional. Currently, Windows XP is the world's most popular OS, though the next version—Windows Vista—has already been out for some time.


Two NVIDIA cards on PCIe slots in SLI mode

2002
Crossing The Billion PC Mark

April 17: PCIe

The PCI-Express standard was launched. A new era of graphics technology was brought to the forefront because of this. PCI (Peripheral Connect Interface) was slow, offering a data bandwidth of just 133 MBps. Considering that the average Pentium 4 CPU was capable of 2.1 GBps, PCI was functioning at a snail's pace. AGP (Accelerated Graphics Port) was brought in to try and reduce this, and the latest version of AGP 8X was capable of an impressive 2.1 GBps bandwidth. However, with graphics, no amount of speed is ever enough, and with other components getting faster, a new interface was needed that not only connected graphics cards but controllers for other high speed devices as well. PCI-Express (PCIe) was the answer, and offered a slightly higher 2.5 GBps bandwidth. PCIe x16 slots increased this to 4 GBps (almost double that of AGP 8x), and graphics manufacturers found a better way to utilise this available bandwidth to use two PCIe x16 ports to split the 16 available bandwidth lanes and add on two graphics cards. ATI's Crossfire and NVIDIA's SLI enabled the enthusiast gamer to run two graphics cards in tandem and experience a much higher level of graphics quality.

June 30: A billion PCs

Research firm Gartner announced that over 1 billion PCs had been shipped to users since the beginning of the technology era. This does not mean there are 1 billion PC users in the world, however, because it counts the number of PCs shipped, and since the 1970s, end users may have gone through anything from three to 10 PCs each. The news was big though, and marked the dominance of technology in the global market share.

August 24: Jaguar follows Puma

Apple released Jaguar (Mac OS X 10.2). It is from this point on that Apple started referring to and marketing their OS upgrades using the codenames instead of the version numbers. Jaguar brought

with it increased speed, better support for networking with Windows-based PCs, iChat (an AOL IM client), a spam filter and more.

November 7: XP for the TabletPC

Microsoft released the TabletPC Edition of their popular Windows XP Professional OS. This is greeted with wide acclaim, as experts believe that the future of portable computing lies in TabletPCs. Research firms do studies, predict that by 2007, 20 per cent of all laptops sold will be TabletPCs. They're proved wrong as the TabletPC remains an attractive option for only a niche user group. Most end-users opt for cheaper and simpler notebook computers—quite happy with the lack of a stylus and making do with the good old touchpad-and-keyboard system.

December 19: DirectX 9.0—the big leap

Microsoft released DirectX 9.0, a step up from the DirectX 8.x series. The new suite of Microsoft's multimedia APIs enhanced the efficiency of the OS to communicate with games, hardware and drivers and produce better-looking visuals on-screen. DX 9 included a lot of security fixes and technology upgrades, and needed compatible hardware to run it. Graphics card manufacturers soon released drivers for existing cards and new hardware that could make use of the new API suite.

2003
The Birth Of MySpace And Mozilla

March 28: Windows Server 2003

Microsoft announced the release of Windows Server 2003. The new server OS promised up to a 30 per cent increase in efficiency and double the speeds. This server OS was initially shipped in four different editions: Windows Server 2003: Standard, Enterprise, Datacenter and Web editions. In later years, the popularity of this server OS grew by leaps and bound to the point where it overtook Linux as the preferred OS for servers sometime in 2005.

July 12: Mozilla

Mozilla.org founded the Mozilla Foundation, established to oversee the development and distribution of all Mozilla products. These products included the Gecko browser, and the foundation is famous for having later released Firefox, the second-most popular browser today.

MySpace is the most popular social networking site today

August 15: MySpace

Started on this day by eUniverse, a company that managed quite a number of community sites, MySpace had a huge advantage over its competitors: with sites such as Skilljam (a gaming site) and CupidJunction (a dating site), plus an e-mail subscriber base, eUniverse already had 20 million existing subscribers that they were able to tap into. All of those users were informed about MySpace and as a result, it was at the top of the social networking scene in no time flat. Currently, MySpace is the most popular social networking site—and in the top five most popular English language sites on the Net! Interestingly, there are several dissenters of MySpace's policy and alleged censorship, and if you're interested in reading more about the conspiracy theories that abound about MySpace, visit FreeMySpace.com for more information.

September 23: The Athlon 64

AMD released their Athlon 64 line of CPUs. With these 64-bit CPUs that were outperforming any similarly-priced Intel CPUs, AMD stamped their dominance on the "performance" front. The success of these CPUs would see AMD's market shares rise considerably. The Athlon 64 series of CPUs was to dominate the performance crowns in hardware tests for just under two years, and were later toppled by Intel's Core and Core 2 in 2006.

November 18: China and its EVD

A consortium of Chinese companies announced the release of the EVD disc format to combat the aging DVD. Enhanced Versatile Disc is not really a different disc format like HD-DVD or Blu-ray, but more of a playback format. Instead of using MPEG-2 compression for video, it uses its own algorithm to store higher-definition movies on regular DVDs. The Chinese consortium was backed by the Chinese government to create EVD because of the royalty costs associated with DVDs. Basically, for every DVD player that's manufactured, the maker has to pay about $15 (about Rs 600) in licensing fees for MPEG-2, the Content Scrambling System (the ability to read digitally copy-protected DVDs), Macrovision (an analogue copy-protection system), and all the various surround-sound filters. EVD, on the other hand, costs hardware manufacturers just $2 (Rs 80) per hardware player in terms of licensing. Like HD-DVD, EVD is capable of 1080i (1920 x 1080) high-definition resolutions, though Blu-Ray is 1080p-capable. Currently, it's all HD-DVD and Blu-Ray, though, and as of 2007, EVD remains pretty much confined to China—which is a big enough market anyway.

2004
Gaming Galore: Half-Life 2, Doom 3 and WoW!

April 1: Gmail!

April Fool's day, Google announces the release of Gmail. Google claims that the idea of Gmail came from complaints of regular e-mail users, whining about how hard it was to find older e-mails, and how the space limits were irritating. Gmail was born from a programmer's mandatory 20-per cent-time—everyone in Google is encouraged to spend a day a week on personal projects. Google also hit the jackpot by initially making Gmail an "invitation-only" service. Great human psyche study there—announce the release of something, make it invite only so that everyone knows that they can't have one, and obviously, everyone then wants one at any cost. Another innovation that Google made with Gmail was to do

away with the folder structure that all Web-mail providers had, and introduce the idea of labels and conversations—so when someone replies to a mail that you sent, it's displayed along with your mail, and all replies from there on are displayed in chronological order. Gmail also offered 1 GB of storage space, and this at a time when other mail providers were offering a mere 4 MB! With a Gmail account, you could send e-mails with attachments that were larger than the total storage space available on other free e-mail providers. Thanks to Gmail, the other providers were forced to offer users more account space—so whether you have a Google account or not, you are reaping the benefits of what Gmail introduced to the world.

April 14: The Lindows case

Lindows changes its name to Linspire. Linux distros were always considered to be something that geeks used. Terminal windows, commands, and all those geeky things that caused the average Windows user to shudder at the mention of the word "Linux" were done away with in one particular Linux distribution called Lindows. Now any idiot can see that the word Lindows comes from a merger of "Linux" and "Windows," and this is what got it into trouble. Lindows was, very shamelessly, a distro that did everything it could to copy Windows, so that if one shifted over to Windows from Lindows, the change would hardly be perceptible. This, of course, prompted Microsoft to sue, and often. Lindows had lawsuits filed against it in several countries, including France and the US. Lindows finally gave up and succumbed to Microsoft's might, and changed its name to Linspire.

August 3: And then, Doom 3

The much awaited sequel in the Doom series of video games, Doom 3 was released to the world. This first-person shooter is known for being scary and abounds with jumpy moments for fans. At the time of the release, no one had seen anything quite like Doom 3—the graphics were great, the shadow effects superlative and the gameplay could stop hearts because of some really scary-looking monsters. The only thing that ruined the experience was

the fact that your character could not multitask—in the sense that although almost every level in the game is poorly lit (to increase the scare factor no doubt), and you do have a flashlight, but you can't wield both the flashlight and a gun at the same time! This forced players to creep along looking for demons to kill, and after spotting one, quickly switch the light off, get a gun in hand and shoot wildly at where the monster was. Also, there's no fun in shining your flashlight around a corner, seeing a demon and then not have the time to switch to guns before he kills you...


Here's what you see in Doom 3

November 9: Halo 2 for the Xbox

Halo 2 is released for the Xbox amidst much fanfare by Bungie Studios. The game grew in popularity quite quickly, and was to become the top selling game for the Xbox and also was the most popular game on Microsoft's Xbox Live! Service until it was dethroned years later by Gears Of War in 2006. Today, Halo 2 is among the top 25 selling games of all time with over 8 million copies sold worldwide.

Halo 2 on the Xbox

Half-Life 2, the best game of the year 2004

November 16: Half-Life 2

Finally! After waiting five years, fans were treated to the sequel of the extremely popular 1999 game Half-Life. Gordon Freeman (the character one plays) returned on November 16, 2004 in Half-Life 2. We don't think we need to tell you any details about what this game involves, and if you haven't played it, what are you sitting around reading this for? Go play it—this book can wait! Half-Life 2 (HL2) was such a success that it won over 35 "Game of the year" awards in 2004. Need we say more?

November 24: WoW!

Plans to make the game World of Warcraft were announced in September 2001, but the game was finally released to the online world on this day in 2004. In the first few months after the launch, this MMORPG (massively multiplayer online role playing game) became so popular that the servers were soon overloaded. Despite being a paid service, the game has over 9 million monthly subscribers today, and is by far the most popular MMORPG of all time.

December 8: The Lenovo deal

IBM, which was at one point in time the world's largest PC manufacturer, announced that it would sell off its personal computing division to Chinese firm Lenovo. The price for buying IBM's PC division was fixed at $1.75 billion (about Rs 7,000 crore). For Lenovo, which was already China's largest PC manufacturer, this meant being propelled straight into being the world's third largest PC manufacturer.

2005
The Year Of YouTube

February 15: YouTube...

In mid-February of 2005, a site went live. The idea was simple: allow everyday Net users to upload videos they create and allow them to share it with the world. Who knew! Today, YouTube is a phenomenon that's swept the world, and it's the fourth-most-popular site on the Net according to Alexa's traffic rankings. In true Web 2.0 style, YouTube brought the power of sharing and networking to the world, and did it with videos instead of vital stats.

April 25: XP Pro x64: no big deal

Microsoft released Windows XP Professional x64—the 64-bit version for those with 64-bit CPUs. The aim was to bring 64-bit computing into the mainstream, and take advantage of the higher performance and security that applications made for 64-bit have to offer. However, despite the fact that most of the computers sold in the past few years have been 64-bit capable, the lack of knowledge on the end-user's behalf and the dearth of true 64-bit applications out there haven't seen too much of a rise in the popularity of Windows XP Professional x64.

May 15: Adobe / Macromedia

Adobe completed its takeover of Macromedia, which it bought for an all-stock transaction of 3.4 billion dollars (Rs 13,600 crore). This made Adobe the largest creative design software company by far. With Adobe's own Acrobat, Photoshop, Illustrator, InDesign, Premiere, etc., and Macromedia's Dreamweaver, Flash, ColdFusion, etc., the new Adobe became a huge force in design and imaging software.

July 14: IBM and OS/2

IBM announced that OS/2 would officially be dead to them after December 23 the same year. It would only sell it till December 23, 2005, and support would actually end a week earlier on December 16, 2005. OS/2 had been around since 1987, made in collaboration between Microsoft and IBM until 1990, when IBM took over.

July 23: Longhorn becomes Vista

Microsoft announced that its long-awaited and much hyped OS "Windows Longhorn" would now be re-christened Windows Vista. Release dates were still sketchy, and users were tired of hearing about the Windows XP successor; "Release it already!" was probably the single most popular thought that people had when they heard the news of the renaming.

September 12: eBay and Skype

eBay announced its plans to buy Skype—a popular Internet telephony company—for $2.6 billion (Rs 10,400 crore). After buying online payment company PayPal in 2002, this move gave eBay the advantage of controlling the most popular resources in two very huge fields—eCommerce (eBay and PayPal) and Internet voice communication (Skype).

2006
Core 2, Zune, And Google Buys YouTube

January 5: Intel's Core

Intel unveiled the Core series of processors. This was seen as the beginning of the end of AMDs short-lived dominance in terms of CPU price and performance because Intel's Cores started winning benchmarks again. Within a few months (read on to find it), Intel went even a step further by introducing the Core 2 series of CPUs, thus re-stamping their dominance of the CPU market, and ending AMDs short stint at the top of the performance charts.

March 31: The first HD-DVD player

Toshiba launched the world's first commercially available HD DVD player, and thus began the HD wars. With everything visual already moving to high definition—camcorders, display devices, movie titles, etc.—the war between the two most popular HD disc formats, HD-DVD and BD (Blu-ray Disc), was given a shot in the arm with the release of hardware players. Later, in May of the same year, Toshiba launched the first HD-DVD-capable PC drive.

July 27: Core 2 steps in

Intel's Core 2 architecture came just half a year after they had released the Core architecture. The new Core 2 CPUs were faster and ran cooler than anything previously made by either Intel or AMD. The popularity of Core 2 grew quickly, and is perhaps the CPU architecture that prompted the quick rise in dual-core and quad-core CPU popularity as well. Currently, you can go out and buy a four-core Core 2 CPU titled Core 2 Quads. Although Intel has already showcased poly-core CPUs (eight and more), the quad-CPU Core 2s are the fastest CPUs you can buy on the planet as of this writing.

October 9: The Google / YouTube thing

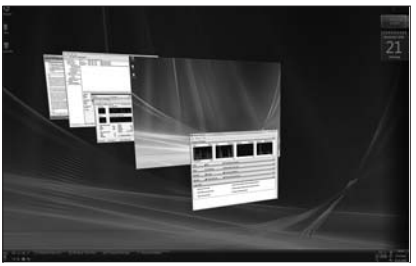
What do you do when you start an online service, then some upstart comes along, does things better and kills your service? You buy it, of course! Well, if you're Internet giant Google, you do. Since Google Video was kind of languishing, and YouTube had taken the world by storm, Google bought it over for $1.65 billion (Rs 6,600 crore). The paranoid screamed "Big Brother", the majority didn't care less, and some companies saw dollar signs and promptly sued YouTube for copyrighted videos that had been on there for quite a while. Regardless, YouTube marches on as the fourth-most popular site on the entire Internet, and stockholders in Google and YouTube are laughing maniacally all the way to their respective banks.

November 14: And then, Microsoft's answer to the pod...

Microsoft released its much-hyped Zune portable media player to the world. The media hyped it so much that it was bound to fail; after all, all those iPeople didn't want to hear about Zune being the iPod killer—especially after shelling out hundreds of dollars on an Apple iPod! It doesn't really matter anyway, because despite all those Zunes being sold, there wasn't even a visible dent in iPod sales—so Apple couldn't be bothered.

2007
Vista And The iPhone—News You've Already Read...

We're not dwelling much on events in the past few years and only sticking to the important ones because you're probably aware of them all anyway. However, there were a few important events in 2007 that we feel you ought to be reminded of:



Windows Vista's Flip 3D under Aero: A prettier way to [Alt] + [Tab]

January 1: Apple Inc.

Apple Computer announced that it would drop the word "Computer" from its name, and from now on be known as only Apple. This decision was made because the company wanted to be known as one that deals with more than just computers. Very logical move actually, what with the fact that the company's most successful product, ever, was in fact the iPod—not anywhere close to as complicated as a PC!

January 30: Vista is out

Microsoft finally released Windows Vista to the general public. This was Microsoft's first OS after Windows XP was released over half a decade ago. With a focus on security and prettiness, Windows Vista was already killing the average onboard graphics chip that a lot of people had, and was Microsoft's first OS to demand a considerably powerful graphics card.

June 29: The iPhone's for real

What started as an Internet hoax about Apple getting into the mobile phone manufacturing business, and even some imaging jokes that found their way into our e-mail boxes some time ago, actually came true. Apple released the iPhone to the world—actu-

ally, only to AT&T subscribers in the US. Featuring the Apple patented multi-touch technology, the iPhone is all touchscreen and features menu controls that you can use two fingers to navigate through. No word still on availability in India of the iPhone, sadly.

The Apple iPhone

End 2007 / Early 2008: Let's see!

We may have only crossed the one billion PC mark in 2002, but doubling that achievement will come a lot faster. The first one billion may have taken over 30 years, but the second billion will take less than 6 years. Because it's a near-future event, we can't give you specifics, but we do know that it will happen by the end of 2007 or sometime in early 2008, depending on how many people buy PCs now. Now don't you go about ruining all the fun by postponing that buy-a-PC plan!

The New Millennium

Here we'll detail the notable events that happened in computing between the years 2001 and 2007. Over the past seven years, technology has jumped forward considerably; however, instead of reinventing the wheel, we seem more inclined to perfecting existing technology. Every single one of you reading this book has lived through the events we detail here, and will agree that this is the decade of innovation, not invention—where a good idea *uses* technology to become a success, rather than the technology *being* the idea.

2000
The Dotcom Bubble

January: Jobs returns to Apple

Steve Jobs was appointed full-time CEO of Apple Computer. After having been chucked out of the company more than a decade earlier, Steve Jobs had started NeXT, which was ultimately bought by Apple.

January: The Transmeta Crusoe

Transmeta launched the x86 processor Crusoe, focusing on energy efficiency. The first processor was the 700 MHz TM3120. Unlike the leading players like Intel and AMD, Transmeta's CPU offered significantly lower performance at the same clock speed. But consider that it consumed only 10 per cent of the power! This made it ideal for laptops where battery backup time was a crucial factor. While the company did not make significant inroads into the Desktop PC market, it did help in focusing attention on the issue of power consumption, and ratios like performance per watt.

The Dotcom/Internet Bubble

From mid-1998 to mid-2001, the NASDAQ, an index that tracks mostly technology stocks, went from the 1500 level to a peak of 5000 in mid-2000 before plunging back to the 1500 levels a year later. This period is referred to as the Dotcom/Internet bubble, since most of the stocks that saw the sudden increase and equally sudden decrease in their stock prices were those of Internet-based businesses.

After the release of the first graphical browsers - Mosaic and Netscape - the popularity of the Internet grew exponentially. A new breed of entrepreneurs realised the business potential of the internet, and the convenience of doing business on the Internet. It was feared that dot-coms would lay to waste all businesses in the real world, referred to as brick-and-mortar companies. Many reasons are proposed to explain the sudden spike in investor interest in online company stocks. Since the Internet was a new medium,

The Graphics Card Industry

The 1991 to 2000 decade saw the establishment of the PC as a viable entertainment platform - games as well as movies. While consoles from Atari, Nintendo, and Sega were popular in the first half of the decade, with PCs becoming more affordable and the number of homes with PCs increasing, towards the end of the decade PCs had become a force to reckon with.

Graphics cards that existed at that time were primarily for 2D graphics, since 2D was being used by high-end workstations. Video games used 3D graphics, and this created a different market segment. Factors that influenced the graphics card industry included the release of PC-only games like ~Quake~, the introduction of the AGP interface, and the introduction of DirectX as a major graphics API in a market with many proprietary graphics API like 3dfx's Glide.

3dfx was the first graphics card manufacturer that released a card specifically for gaming, in the form of the Voodoo, in 1996. Being unable to deal with 2D load, systems required a separate graphics card in addition to the Voodoo, but the card proved popular nevertheless. 3dfx saw considerable success with every version of the Voodoo series. The last in the series was the Voodoo 5.

NVIDIA, whose first chip, the NV1, used a different graphics rendering method from that supported by DirectX, had to create an entirely new design that was released as the Riva 128. NVIDIA followed this up with the Riva TNT, and then the Riva TNT2... then the GeForce 256 and GeForce 2 families. The Riva TNT2 proved too good a match for the 3dfx Voodoo 2, and helped NVIDIA become market leader. In 2000, NVIDIA took over 3dfx.

Through these years, ATI released the Mach and Rage series of graphics cards which helped it to maintain its position in the market. This situation changed with the Radeon series, when it began challenging NVIDIA.

Besides these, there were others like Cirrus Logic, S3, Matrox, SiS, Intel, and 3D labs. S3 was acquired by Via and their know-how was used to create onboard graphics for Via chipsets; Intel and SiS gave up their pursuits in the field of discrete cards and focused on offering onboard solutions. Matrox focused on 2D graphics.

people were not sure what direction it could take, and so were willing to take the additional risk to be part of the impending gold rush. The usual yardsticks employed to assess the attractiveness of brick and mortar company stocks were not used in case of the dot-coms. Mass media played a role in creating the hype surrounding the new age entrepreneurs. In any case, companies with little or no prior experience and those who lacked any practical business plan were able to attract investment from the public. Many company stocks were quickly overvalued, making the investors and the founders rich, at least on paper. Companies like Netscape Communications saw their stock prices increase manifold overnight making billionaires of their founders.

The reasons for the bursting of the bubble is, again, not clear... After the smooth passage into the new millennium, companies that had invested in redundant hardware as a precaution against the effects of the Y2K phenomenon were not giving any more orders. The outsourcing phenomenon had also begun to dig into investor confidence. In any case, once investors began to realise that the stock prices were overvalued many times over, the selling began. Companies that were the toast of the town suddenly declared bankruptcy (like Pets.com); many were bought out by more capable buyers (Netscape was bought by AOL); the rest scaled down to a more practical and realistic level. It is estimated that with the burst of the bubble, approximately $1.75 trillion (Rs 84 lakh crore) in market value was lost.

2001
The Year Of The iPod, Windows XP And Xbox

January 1: Out, 95

The first day of the year, Microsoft announced that it would no longer be shipping Windows 95 to customers. They termed the ageing OS a "legacy item," which is a lot less than we would say if given the chance! Anyway, this move was expected as later the same year Microsoft would release Windows XP.

January 6: The Xbox

Microsoft unveiled the final version of the Xbox to the world. Bill Gates himself did the honours at CES Las Vegas, and pulled back the curtain on Microsoft's venture into the gaming console arena. This was quite an important event in technology history because it marked the beginning of a heated battle between Microsoft and Sony in terms of gaming consoles—a battle that rages on even today.

Here an image of the Xbox released to the press, back in 2001

January 15: Intel and Xircom

Intel announced that it would buy over Xircom Inc., a company best known for connectivity solutions for mobile devices. Xircom also marketed memory cards, LAN adapters and modems. After being acquired by Intel, Xircom produced CompactFlash connectivity devices such as Ethernet and modem adapters for handheld devices. Intel continued to sell networking products under the Xircom name for a long time, till October 2005.

March 24: Cheetah

Apple released Mac OS X (v10.0), codenamed Cheetah. Unlike what

we know of Apple software these days, Cheetah was slow and lacked a lot of features. Critics opined that it was an OS that was not near ready for release. Being a complete platform up from Mac OS 9, and not just another upgrade, the release also meant that OS X had little or no compatible applications available to early adopters—another rather large bee in the average computer user's bonnet. However, Apple is notorious for having fans that vociferously defend its every move, and the early release of OS X was widely applauded by fans. As you will read later, Cheetah was soon followed by Puma (v10.1) in September 2001.

March 31: Quantum—Maxtor—Seagate

Quantum, once one of the biggest hard drive manufacturers, announced that it would be selling its hard drive business to Maxtor. At this point in time, there was a raging battle in the hard drive segment, with companies trying to outdo each other on prices. This cut-throat nature of the competition prompted Quantum stock holders to vote positively towards the decision to get out of the end-user hard drive segment and focus on tape and other media still popular with the corporate. Interestingly, not much later (in 2005), Maxtor itself was bought over by Seagate, and the price battle in this segment continues even today—which is a great thing for we the end-users.

April 11: Clippit—get off my document!

Microsoft announced that future versions of MS Office would no longer include Clippit—the animated paperclip that used to pop up when you were writing something in Word and said, "It looks like you're writing a letter. Would you like help?" Microsoft even made ad cartoons, making fun of Clippit and announcing that Office XP onwards it was curtains for Clippit. Of course, Clippit was present in Office XP, and was just disabled by default, so the seven fans of Clippy in the world could turn that feature back on again if they desired. In Office 2003, Clippit wasn't installed by default, but if you had the MS Office 2003 CD, you could choose to install him. It's only with Office 2007 that Clippit was actually removed, and that there was no way to install him. Watch the car-

toon ad videos of Clippy on YouTube:

www.youtube.com/watch?v=rBO3aRifPLU
www.youtube.com/watch?v=uJCv8ru3L98
www.youtube.com/watch?v=sMShkAZR1-Q

April 20: Dell's big

A typical online gambling site

Dell officially took over the title of "World's Largest PC Manufacturer" from Compaq. This is a significant point in branded PC history because it was the first change of the crown in over seven years. Compaq ruled the roost from 1994 to early 2001. Before that, IBM was on top from 1991 to 1994, and just for the year 1990, Apple found itself to be the world's largest PC maker. In more recent history, we've seen HP and Dell, then HP-Compaq and Dell swap the crown between themselves. However, the toppling of Compaq's seven-year reign (the longest ever) is something that we're sure puffs up Dell employees' chests to this day.

June 4: Online gambling

Nevada becomes the first US state to legalise online gambling. This event saw a huge boom in online gambling sites, because it now meant that such sites could be hosted on US soil. Although Internet users can come from anywhere on the globe, the legality of the site only comes into question based on where the site is hosted. Before this legislation was passed, most online gambling sites were hosted in Europe, where the laws against gambling are much softer. Online gambling continues to be a big industry, with most of the bets being placed from US-owned IP addresses and accounts. Laws in the US are still unclear about online gambling, since no law of any state prohibits it—though offline gambling is prohibited in most states. It seems apt that Nevada, home to Las

Vegas, was the first to legalise and regulate online gambling. Incidentally, hosting an online gambling site back in 2001 meant coughing up half a million dollars in license fees and then $250,000 every year afterwards!

August 29: SATA

The Serial ATA specifications were released at the Intel Developer Forum (IDF). Serial ATA (SATA) would eventually replace Parallel ATA (PATA) as the standard for connecting devices to the motherboard in the average home PC. Advantages include higher bandwidth, smaller connectors, fewer pins and thinner cables to make the insides of our cabinets more manageable, also improving motherboard design and making in-cabinet heat dissipation simpler. Currently, the most popular interface is revision 2 of SATA, which offers 300 MBps transfer rates.

September 6: The HP-Compaq deal

Hewlett-Packard (HP) announced that it planned to buy Compaq in a stock-for-stock deal that would cost them about 25 billion dollars (1 lakh crore rupees). This deal made HP-Compaq the largest PC manufacturer in the world, and also the world leader in printing solutions.

September 25: Puma follows Cheetah

Apple followed up Mac OS X 10.1 (Cheetah) with 10.2 (Puma). This upgrade was significantly better than Cheetah, and brought with it better performance and filled in the cracks in Cheetah—DVD playback being the most important. A significant visual change also occurred, when the start up screen saw the death of the "Happy Mac" icon to a prettier and more sober grey Apple start up icon. The Happy Mac icon was something Apple users had seen at their start up screens for over 18 years—aeons in terms of technology businesses!

October 23: The day of the pod

Apple announced the release of its portable media player called the iPod. Today, the iPod remains the highest-selling portable

media player to date, and is Apple's flagship product. As of 2007, Apple has sold over 110 million iPods across the globe. It has also sparked an entire market of its own, with manufacturers from across the globe making iPod accessories. The iPod is such a common site across the US that the term iPeople was conjured up to describe the millions walking around with ears plugged, dancing to the music their iPods belted out. Need we say more?

The first generation of iPods

October 25: XP

Microsoft released the next version of their operating system, Microsoft Windows XP. The Windows XP Professional and Windows XP Home flavours were released first, with subsequent versions to follow. This was the first time Microsoft was making many versions of the OS for end-users—it was earlier just a distinction between server and end-users. It also meant that people would have to choose more carefully what they were buying a computer for, and pick between Windows Home and Professional. Currently, Windows XP is the world's most popular OS, though the next version—Windows Vista—has already been out for some time.


Two NVIDIA cards on PCIe slots in SLI mode

2002
Crossing The Billion PC Mark

April 17: PCIe

The PCI-Express standard was launched. A new era of graphics technology was brought to the forefront because of this. PCI (Peripheral Connect Interface) was slow, offering a data bandwidth of just 133 MBps. Considering that the average Pentium 4 CPU was capable of 2.1 GBps, PCI was functioning at a snail's pace. AGP (Accelerated Graphics Port) was brought in to try and reduce this, and the latest version of AGP 8X was capable of an impressive 2.1 GBps bandwidth. However, with graphics, no amount of speed is ever enough, and with other components getting faster, a new interface was needed that not only connected graphics cards but controllers for other high speed devices as well. PCI-Express (PCIe) was the answer, and offered a slightly higher 2.5 GBps bandwidth. PCIe x16 slots increased this to 4 GBps (almost double that of AGP 8x), and graphics manufacturers found a better way to utilise this available bandwidth to use two PCIe x16 ports to split the 16 available bandwidth lanes and add on two graphics cards. ATI's Crossfire and NVIDIA's SLI enabled the enthusiast gamer to run two graphics cards in tandem and experience a much higher level of graphics quality.

June 30: A billion PCs

Research firm Gartner announced that over 1 billion PCs had been shipped to users since the beginning of the technology era. This does not mean there are 1 billion PC users in the world, however, because it counts the number of PCs shipped, and since the 1970s, end users may have gone through anything from three to 10 PCs each. The news was big though, and marked the dominance of technology in the global market share.

August 24: Jaguar follows Puma

Apple released Jaguar (Mac OS X 10.2). It is from this point on that Apple started referring to and marketing their OS upgrades using the codenames instead of the version numbers. Jaguar brought

with it increased speed, better support for networking with Windows-based PCs, iChat (an AOL IM client), a spam filter and more.

November 7: XP for the TabletPC

Microsoft released the TabletPC Edition of their popular Windows XP Professional OS. This is greeted with wide acclaim, as experts believe that the future of portable computing lies in TabletPCs. Research firms do studies, predict that by 2007, 20 per cent of all laptops sold will be TabletPCs. They're proved wrong as the TabletPC remains an attractive option for only a niche user group. Most end-users opt for cheaper and simpler notebook computers—quite happy with the lack of a stylus and making do with the good old touchpad-and-keyboard system.

December 19: DirectX 9.0—the big leap

Microsoft released DirectX 9.0, a step up from the DirectX 8.x series. The new suite of Microsoft's multimedia APIs enhanced the efficiency of the OS to communicate with games, hardware and drivers and produce better-looking visuals on-screen. DX 9 included a lot of security fixes and technology upgrades, and needed compatible hardware to run it. Graphics card manufacturers soon released drivers for existing cards and new hardware that could make use of the new API suite.

2003
The Birth Of MySpace And Mozilla

March 28: Windows Server 2003

Microsoft announced the release of Windows Server 2003. The new server OS promised up to a 30 per cent increase in efficiency and double the speeds. This server OS was initially shipped in four different editions: Windows Server 2003: Standard, Enterprise, Datacenter and Web editions. In later years, the popularity of this server OS grew by leaps and bound to the point where it overtook Linux as the preferred OS for servers sometime in 2005.

July 12: Mozilla

Mozilla.org founded the Mozilla Foundation, established to oversee the development and distribution of all Mozilla products. These products included the Gecko browser, and the foundation is famous for having later released Firefox, the second-most popular browser today.

MySpace is the most popular social networking site today

August 15: MySpace

Started on this day by eUniverse, a company that managed quite a number of community sites, MySpace had a huge advantage over its competitors: with sites such as Skilljam (a gaming site) and CupidJunction (a dating site), plus an e-mail subscriber base, eUniverse already had 20 million existing subscribers that they were able to tap into. All of those users were informed about MySpace and as a result, it was at the top of the social networking scene in no time flat. Currently, MySpace is the most popular social networking site—and in the top five most popular English language sites on the Net! Interestingly, there are several dissenters of MySpace's policy and alleged censorship, and if you're interested in reading more about the conspiracy theories that abound about MySpace, visit FreeMySpace.com for more information.

September 23: The Athlon 64

AMD released their Athlon 64 line of CPUs. With these 64-bit CPUs that were outperforming any similarly-priced Intel CPUs, AMD stamped their dominance on the "performance" front. The success of these CPUs would see AMD's market shares rise considerably. The Athlon 64 series of CPUs was to dominate the performance crowns in hardware tests for just under two years, and were later toppled by Intel's Core and Core 2 in 2006.

November 18: China and its EVD

A consortium of Chinese companies announced the release of the EVD disc format to combat the aging DVD. Enhanced Versatile Disc is not really a different disc format like HD-DVD or Blu-ray, but more of a playback format. Instead of using MPEG-2 compression for video, it uses its own algorithm to store higher-definition movies on regular DVDs. The Chinese consortium was backed by the Chinese government to create EVD because of the royalty costs associated with DVDs. Basically, for every DVD player that's manufactured, the maker has to pay about $15 (about Rs 600) in licensing fees for MPEG-2, the Content Scrambling System (the ability to read digitally copy-protected DVDs), Macrovision (an analogue copy-protection system), and all the various surround-sound filters. EVD, on the other hand, costs hardware manufacturers just $2 (Rs 80) per hardware player in terms of licensing. Like HD-DVD, EVD is capable of 1080i (1920 x 1080) high-definition resolutions, though Blu-Ray is 1080p-capable. Currently, it's all HD-DVD and Blu-Ray, though, and as of 2007, EVD remains pretty much confined to China—which is a big enough market anyway.

2004
Gaming Galore: Half-Life 2, Doom 3 and WoW!

April 1: Gmail!

April Fool's day, Google announces the release of Gmail. Google claims that the idea of Gmail came from complaints of regular e-mail users, whining about how hard it was to find older e-mails, and how the space limits were irritating. Gmail was born from a programmer's mandatory 20-per cent-time—everyone in Google is encouraged to spend a day a week on personal projects. Google also hit the jackpot by initially making Gmail an "invitation-only" service. Great human psyche study there—announce the release of something, make it invite only so that everyone knows that they can't have one, and obviously, everyone then wants one at any cost. Another innovation that Google made with Gmail was to do

away with the folder structure that all Web-mail providers had, and introduce the idea of labels and conversations—so when someone replies to a mail that you sent, it's displayed along with your mail, and all replies from there on are displayed in chronological order. Gmail also offered 1 GB of storage space, and this at a time when other mail providers were offering a mere 4 MB! With a Gmail account, you could send e-mails with attachments that were larger than the total storage space available on other free e-mail providers. Thanks to Gmail, the other providers were forced to offer users more account space—so whether you have a Google account or not, you are reaping the benefits of what Gmail introduced to the world.

April 14: The Lindows case

Lindows changes its name to Linspire. Linux distros were always considered to be something that geeks used. Terminal windows, commands, and all those geeky things that caused the average Windows user to shudder at the mention of the word "Linux" were done away with in one particular Linux distribution called Lindows. Now any idiot can see that the word Lindows comes from a merger of "Linux" and "Windows," and this is what got it into trouble. Lindows was, very shamelessly, a distro that did everything it could to copy Windows, so that if one shifted over to Windows from Lindows, the change would hardly be perceptible. This, of course, prompted Microsoft to sue, and often. Lindows had lawsuits filed against it in several countries, including France and the US. Lindows finally gave up and succumbed to Microsoft's might, and changed its name to Linspire.

August 3: And then, Doom 3

The much awaited sequel in the Doom series of video games, Doom 3 was released to the world. This first-person shooter is known for being scary and abounds with jumpy moments for fans. At the time of the release, no one had seen anything quite like Doom 3—the graphics were great, the shadow effects superlative and the gameplay could stop hearts because of some really scary-looking monsters. The only thing that ruined the experience was

the fact that your character could not multitask—in the sense that although almost every level in the game is poorly lit (to increase the scare factor no doubt), and you do have a flashlight, but you can't wield both the flashlight and a gun at the same time! This forced players to creep along looking for demons to kill, and after spotting one, quickly switch the light off, get a gun in hand and shoot wildly at where the monster was. Also, there's no fun in shining your flashlight around a corner, seeing a demon and then not have the time to switch to guns before he kills you...


Here's what you see in Doom 3

November 9: Halo 2 for the Xbox

Halo 2 is released for the Xbox amidst much fanfare by Bungie Studios. The game grew in popularity quite quickly, and was to become the top selling game for the Xbox and also was the most popular game on Microsoft's Xbox Live! Service until it was dethroned years later by Gears Of War in 2006. Today, Halo 2 is among the top 25 selling games of all time with over 8 million copies sold worldwide.

Halo 2 on the Xbox

Half-Life 2, the best game of the year 2004

November 16: Half-Life 2

Finally! After waiting five years, fans were treated to the sequel of the extremely popular 1999 game Half-Life. Gordon Freeman (the character one plays) returned on November 16, 2004 in Half-Life 2. We don't think we need to tell you any details about what this game involves, and if you haven't played it, what are you sitting around reading this for? Go play it—this book can wait! Half-Life 2 (HL2) was such a success that it won over 35 "Game of the year" awards in 2004. Need we say more?

November 24: WoW!

Plans to make the game World of Warcraft were announced in September 2001, but the game was finally released to the online world on this day in 2004. In the first few months after the launch, this MMORPG (massively multiplayer online role playing game) became so popular that the servers were soon overloaded. Despite being a paid service, the game has over 9 million monthly subscribers today, and is by far the most popular MMORPG of all time.

December 8: The Lenovo deal

IBM, which was at one point in time the world's largest PC manufacturer, announced that it would sell off its personal computing division to Chinese firm Lenovo. The price for buying IBM's PC division was fixed at $1.75 billion (about Rs 7,000 crore). For Lenovo, which was already China's largest PC manufacturer, this meant being propelled straight into being the world's third largest PC manufacturer.

2005
The Year Of YouTube

February 15: YouTube...

In mid-February of 2005, a site went live. The idea was simple: allow everyday Net users to upload videos they create and allow them to share it with the world. Who knew! Today, YouTube is a phenomenon that's swept the world, and it's the fourth-most-popular site on the Net according to Alexa's traffic rankings. In true Web 2.0 style, YouTube brought the power of sharing and networking to the world, and did it with videos instead of vital stats.

April 25: XP Pro x64: no big deal

Microsoft released Windows XP Professional x64—the 64-bit version for those with 64-bit CPUs. The aim was to bring 64-bit computing into the mainstream, and take advantage of the higher performance and security that applications made for 64-bit have to offer. However, despite the fact that most of the computers sold in the past few years have been 64-bit capable, the lack of knowledge on the end-user's behalf and the dearth of true 64-bit applications out there haven't seen too much of a rise in the popularity of Windows XP Professional x64.

May 15: Adobe / Macromedia

Adobe completed its takeover of Macromedia, which it bought for an all-stock transaction of 3.4 billion dollars (Rs 13,600 crore). This made Adobe the largest creative design software company by far. With Adobe's own Acrobat, Photoshop, Illustrator, InDesign, Premiere, etc., and Macromedia's Dreamweaver, Flash, ColdFusion, etc., the new Adobe became a huge force in design and imaging software.

July 14: IBM and OS/2

IBM announced that OS/2 would officially be dead to them after December 23 the same year. It would only sell it till December 23, 2005, and support would actually end a week earlier on December 16, 2005. OS/2 had been around since 1987, made in collaboration between Microsoft and IBM until 1990, when IBM took over.

July 23: Longhorn becomes Vista

Microsoft announced that its long-awaited and much hyped OS "Windows Longhorn" would now be re-christened Windows Vista. Release dates were still sketchy, and users were tired of hearing about the Windows XP successor; "Release it already!" was probably the single most popular thought that people had when they heard the news of the renaming.

September 12: eBay and Skype

eBay announced its plans to buy Skype—a popular Internet telephony company—for $2.6 billion (Rs 10,400 crore). After buying online payment company PayPal in 2002, this move gave eBay the advantage of controlling the most popular resources in two very huge fields—eCommerce (eBay and PayPal) and Internet voice communication (Skype).

2006
Core 2, Zune, And Google Buys YouTube

January 5: Intel's Core

Intel unveiled the Core series of processors. This was seen as the beginning of the end of AMDs short-lived dominance in terms of CPU price and performance because Intel's Cores started winning benchmarks again. Within a few months (read on to find it), Intel went even a step further by introducing the Core 2 series of CPUs, thus re-stamping their dominance of the CPU market, and ending AMDs short stint at the top of the performance charts.

March 31: The first HD-DVD player

Toshiba launched the world's first commercially available HD DVD player, and thus began the HD wars. With everything visual already moving to high definition—camcorders, display devices, movie titles, etc.—the war between the two most popular HD disc formats, HD-DVD and BD (Blu-ray Disc), was given a shot in the arm with the release of hardware players. Later, in May of the same year, Toshiba launched the first HD-DVD-capable PC drive.

July 27: Core 2 steps in

Intel's Core 2 architecture came just half a year after they had released the Core architecture. The new Core 2 CPUs were faster and ran cooler than anything previously made by either Intel or AMD. The popularity of Core 2 grew quickly, and is perhaps the CPU architecture that prompted the quick rise in dual-core and quad-core CPU popularity as well. Currently, you can go out and buy a four-core Core 2 CPU titled Core 2 Quads. Although Intel has already showcased poly-core CPUs (eight and more), the quad-CPU Core 2s are the fastest CPUs you can buy on the planet as of this writing.

October 9: The Google / YouTube thing

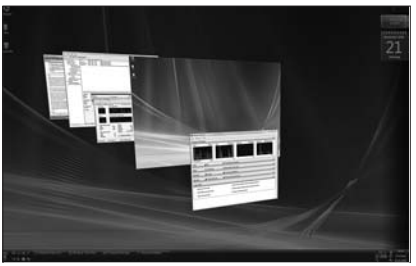
What do you do when you start an online service, then some upstart comes along, does things better and kills your service? You buy it, of course! Well, if you're Internet giant Google, you do. Since Google Video was kind of languishing, and YouTube had taken the world by storm, Google bought it over for $1.65 billion (Rs 6,600 crore). The paranoid screamed "Big Brother", the majority didn't care less, and some companies saw dollar signs and promptly sued YouTube for copyrighted videos that had been on there for quite a while. Regardless, YouTube marches on as the fourth-most popular site on the entire Internet, and stockholders in Google and YouTube are laughing maniacally all the way to their respective banks.

November 14: And then, Microsoft's answer to the pod...

Microsoft released its much-hyped Zune portable media player to the world. The media hyped it so much that it was bound to fail; after all, all those iPeople didn't want to hear about Zune being the iPod killer—especially after shelling out hundreds of dollars on an Apple iPod! It doesn't really matter anyway, because despite all those Zunes being sold, there wasn't even a visible dent in iPod sales—so Apple couldn't be bothered.

2007
Vista And The iPhone—News You've Already Read...

We're not dwelling much on events in the past few years and only sticking to the important ones because you're probably aware of them all anyway. However, there were a few important events in 2007 that we feel you ought to be reminded of:



Windows Vista's Flip 3D under Aero: A prettier way to [Alt] + [Tab]

January 1: Apple Inc.

Apple Computer announced that it would drop the word "Computer" from its name, and from now on be known as only Apple. This decision was made because the company wanted to be known as one that deals with more than just computers. Very logical move actually, what with the fact that the company's most successful product, ever, was in fact the iPod—not anywhere close to as complicated as a PC!

January 30: Vista is out

Microsoft finally released Windows Vista to the general public. This was Microsoft's first OS after Windows XP was released over half a decade ago. With a focus on security and prettiness, Windows Vista was already killing the average onboard graphics chip that a lot of people had, and was Microsoft's first OS to demand a considerably powerful graphics card.

June 29: The iPhone's for real

What started as an Internet hoax about Apple getting into the mobile phone manufacturing business, and even some imaging jokes that found their way into our e-mail boxes some time ago, actually came true. Apple released the iPhone to the world—actu-

ally, only to AT&T subscribers in the US. Featuring the Apple patented multi-touch technology, the iPhone is all touchscreen and features menu controls that you can use two fingers to navigate through. No word still on availability in India of the iPhone, sadly.

The Apple iPhone

End 2007 / Early 2008: Let's see!

We may have only crossed the one billion PC mark in 2002, but doubling that achievement will come a lot faster. The first one billion may have taken over 30 years, but the second billion will take less than 6 years. Because it's a near-future event, we can't give you specifics, but we do know that it will happen by the end of 2007 or sometime in early 2008, depending on how many people buy PCs now. Now don't you go about ruining all the fun by postponing that buy-a-PC plan!